



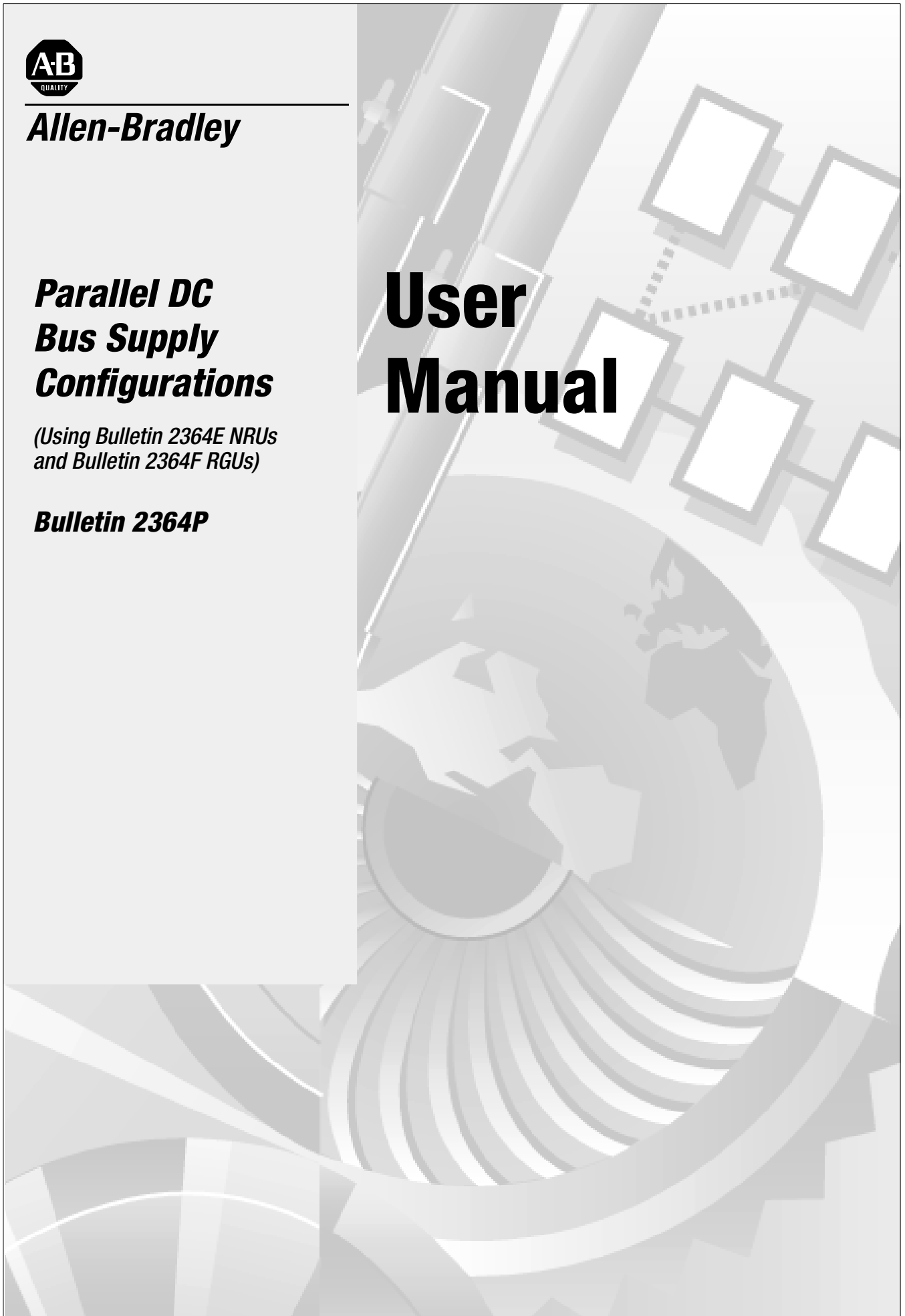
Allen-Bradley

***Parallel DC
Bus Supply
Configurations***

*(Using Bulletin 2364E NRUs
and Bulletin 2364F RGUs)*

Bulletin 2364P

User Manual



Important User Information

Solid-State equipment has operational characteristics differing from those of electromechanical equipment. “*Safety Guidelines for the Application, Installation and Maintenance of Solid-State Controls*” (Publication SGI-1.1) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation be responsible or liable for indirect or consequential damages resulting from the use of application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, the Rockwell Automation cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation with respect use of information, circuits, equipment, or software described in this manual.

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Throughout this manual we use notes to make you aware of safety considerations:



ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

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Preface

Who Should Use This Manual

This manual is intended for those who are responsible for installing or operating an Allen-Bradley parallel DC bus supply configuration.

If you do not have a basic understanding of this product, please read through this manual. Contact your local Rockwell Automation Drive Systems representative if you have questions about the content of this manual or the product.

Purpose of This Manual

This manual contains specifications, installation instructions, and operating instructions for the 2364P parallel configuration.

Safety Precautions

The following general precautions apply when installing, servicing, or operating parallel configurations and drive system lineups:



ATTENTION: Only those familiar with the drive system, the products used in the system, and the associated machinery should plan or implement the installation, startup, and future maintenance of the system. Failure to comply can result in personal injury and/or equipment damage.

ATTENTION: Verify that all sources of AC and DC power are deenergized and locked out or tagged out in accordance with the requirements of ANSI/NFPA 70E, Part II.

ATTENTION: The system may contain stored energy devices. To avoid the hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove a drive system or its components. You should only attempt the procedures in this manual if you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in ANSI/NFPA 70E.



ATTENTION: An incorrectly applied or incorrectly installed drive system can result in component damage and/or a reduction in product life. Wiring or application errors—such as undersizing the motor, incorrect or inadequate AC supply, and excessive ambient temperatures—can result in the malfunction of the drive equipment.

ATTENTION: This drive system contains parts and assemblies that are sensitive to ESD (electrostatic discharge). Static control precautions are required when installing, testing, or repairing this assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to Rockwell Automation publication 8000-4.5.2, *Guarding Against Electrostatic Damage*, or another adequate handbook on ESD protection.

Contents of this Manual

Chapter	Title	Contents
	Preface	Safety precautions, reference tables, and support information.
1	Theory of Operation	Overview of the parallel configurations. Includes basic theory and operational information.
2	R1 and S1-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the R1 and S1-code parallel configurations.
3	R2 and S2-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the R2 and S2-code parallel configurations.
4	R3 and S3-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the R3 and S3-code parallel configurations.
5	R4 and S4-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the R4 and S4-code parallel configurations.
6	T1 and V1-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the T1 and V1-code parallel configurations.
7	T2 and V2-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the T2 and V2-code parallel configurations.
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11	T6 and V6-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the T6 and V6-code parallel configurations.
12	W1-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the W1-code parallel configurations.
13	W2-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the W2-code parallel configurations.
14	W3-Code Parallel Configurations	Schematics, component layout, and overhead bus configuration for the W3-code parallel configurations.
15	Installation	Instructions for installing, wiring, and testing the parallel configuration.
16	Setting Up the Parallel Configuration	Instructions for setting the RGU parameters in the parallel configuration.
A	Specifications	Operational, environmental, and electrical specifications for the parallel configuration.
B	Catalog Numbers and Spare Parts Kits	Information concerning the parallel configuration catalog numbers and spare parts kits.
C	Physical Details	Enclosure dimensions and sound levels.
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Related Documentation

The following documents include information that may be helpful when installing or services components in your drive system. To obtain a copy of any of the Rockwell Automation publications, contact your local Rockwell Automation office or distributor.

For	Read This Document	Document Number
NRU layout diagrams, schematics, component information, and installation/setup instructions.	Non-Regenerative DC Bus Supply Unit (NRU)—User Manual	2364E-5.01
RGU layout diagrams, schematics, component information, installation/setup instructions, and parameter listings.	Regenerative DC Bus Supply Unit (RGU)—User Manual	2364F-5.01
Troubleshooting information, testing procedures, and fault descriptions for the RGU.	Regenerative DC Bus Supply Unit (RGU)—Troubleshooting Guide	2364F-5.05
Instructions for installing an overhead bus assembly.	Overhead Bus Installation Instructions for Bulletin 2300 MCCs	2364P-5.10
Information for operating and understanding the Graphic Programming Terminal (GPT).	Bulletin 1201 Graphic Programming Terminal—User Manual	1201-5.0
Information for installing and configuring the Remote I/O (RIO) Communications Module.	Bulletin 1203 Remote I/O Communications Module—Getting Started Manual	1203-5.1
Information for installing and configuring the DeviceNet Communications Module.	Bulletin 1203 DeviceNet Communications Module—User Manual	1203-5.3
Information for installing and configuring the Series Communications Module.	Bulletin 1203 Series Communications Module—User Manual	1203-5.5
Information for installing, configuring, programming, and troubleshooting the 1336 FORCE adjustable frequency AC drive.	1336 FORCE Adjustable Frequency AC Drive—User Manual	1336 FORCE-5.12
Information for installing, configuring, programming, and troubleshooting the 1336 PLUS adjustable frequency AC drive.	1336 PLUS Adjustable Frequency AC Drive—User Manual	1336 PLUS-5.0
Instructions for properly handling and moving motor control centers.	Receiving, Handling, and Storing Motor Control Centers—Instructions	2100-5.5
Instructions for enclosure and busbar assembly.	Bulletin 2300 Family of Drive Systems—Installation Manual	2300-5.1
Information for installing, configuring, and programming the SA3000 AC drive.	SA3000 Binder	S-3001
Information for installing, configuring, and programming the SA3100 AC drive.	SA3100 Binder	S-3053
Instructions for working with FD86N enclosures.	FD86N Drive Systems Enclosure Hardware—Installation Manual	S-3062
Electrical specifications established by the National Fire Protection Association (NFPA), Boston, MA.	National Electrical Code	ANSI/NFPA70
List of documentation available through Allen-Bradley.	Allen-Bradley Publication Index	SD499
Dictionary of terms that are common to industrial automation.	Industrial Automation Glossary	AG-7.1

Receiving Your Drive System

The Customer is responsible for thoroughly inspecting the equipment before accepting the shipment from the freight company. Check the item(s) that you receive against your purchase order. If any items are obviously damaged, do not accept the delivery until the freight agent has noted the damage on the freight bill. Should you discover any concealed damage during unpacking, you are responsible for notifying the freight agent. In such a case, leave the shipping container intact and request that the freight agent make a visual inspection of the equipment.

Rockwell Automation Support

Rockwell Automation offers support services worldwide, with Sales/Support Offices, authorized distributors, and authorized Systems Integrators located throughout the United States, plus Rockwell Automation representatives in every major country in the world.

Local Product Support

Please contact your local Rockwell Automation representative for:

- sales and order support
- product technical training
- warranty support
- support service agreements

Technical Product Assistance

If you need to contact us for technical assistance, please review the product and troubleshooting information in this manual first.

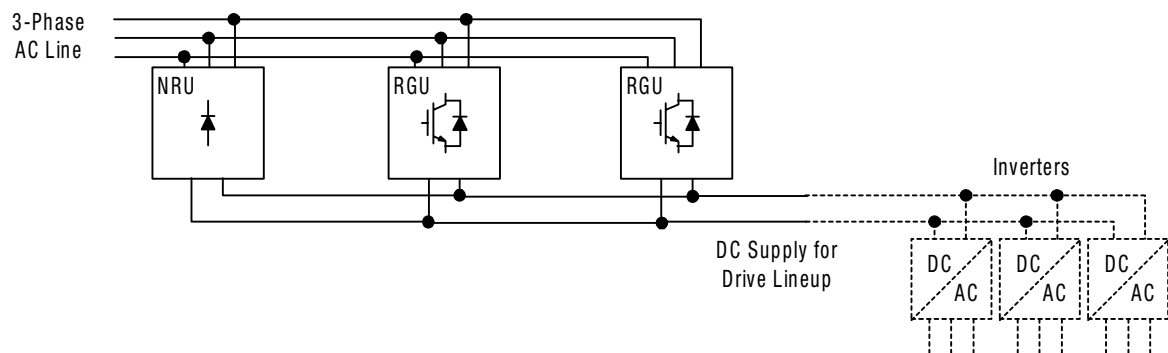
When you do contact us, please have the catalog numbers of your products ready when you call so we can provide the quickest response for your situation.

Theory of Operation

Introduction

The parallel configuration, a DC bus supply front-end with regenerative capability, is used to supply DC power for AC digital drive inverter units in a common bus drive system. Twenty-three different parallel configurations provide a spectrum of different supply and regenerative capabilities.

Figure 1.1
Parallel Configuration



Parallel configurations use the following front-end units:

- Regenerative DC Bus Supply Unit (RGU)
- Non-Regenerative DC Bus Supply Unit (NRU)

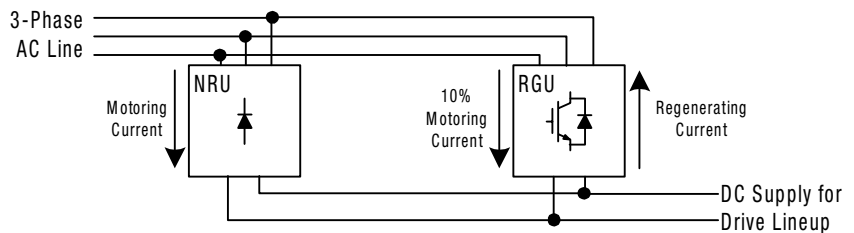
Each parallel configuration will include one, two, or three Regenerative DC Bus Supply Units (RGUs). These units are used to supply motoring current to the DC bus, and are used to regenerate current back onto the AC line.

Most of the parallel configurations will also include a Non-Regenerative DC Bus Supply Unit (NRU) to supply the motoring current to the DC bus.

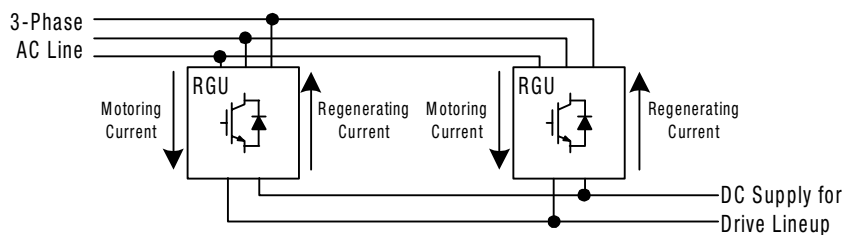
Note: When there is an NRU in the configuration, the NRU supplies motoring current while the RGUs regenerate most of the excess capacity (the RGU also contributes 10% of its rated motoring current to the DC bus).

Figure 1.2
NRU and RGU Operation

NRU//RGU Configuration



RGU//RGU Configuration

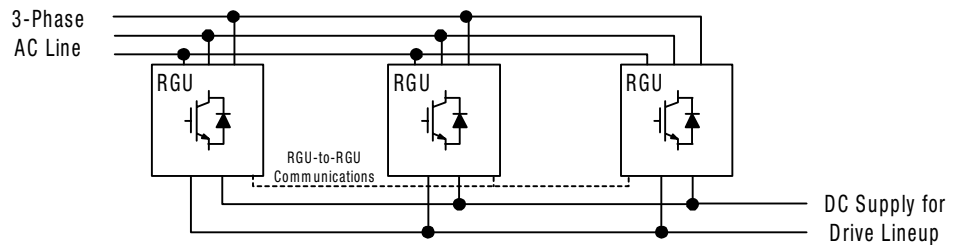


Parallel Configuration

RGU//RGU Configurations

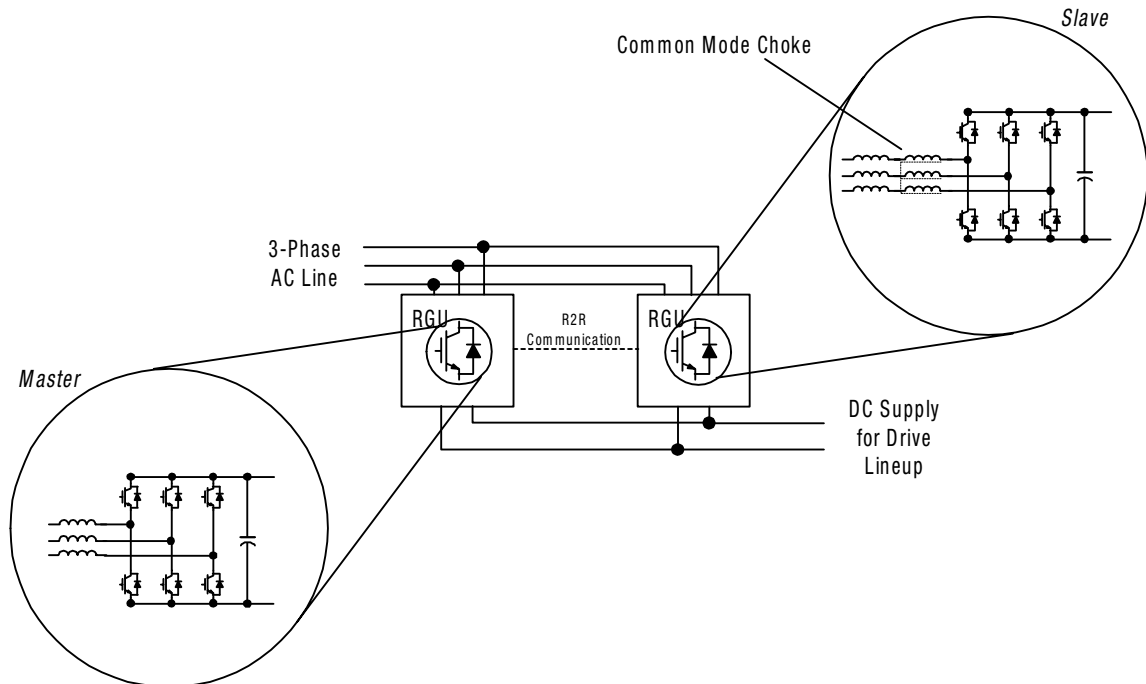
In an RGU//RGU configuration, each RGU supplies 100% motoring current and 100% regenerative current. When operating, the master RGU evaluates the bus voltage and sends current commands to the slave RGUs through an RGU-to-RGU (R2R) communication network. This allows the RGUs to operate together to supply the appropriate current while maintaining a constant voltage on the DC bus.

Figure 1.3
RGU//RGU Configuration



Each RGU//RGU configuration has one master RGU in parallel with either one or two slave RGUs. Each slave RGU includes a common mode choke accommodate for minor switching differences between the RGUs and to reduce circulating currents between the master RGU and the slave RGUs.

Figure 1.4
RGU//RGU Configuration—Master/Slave

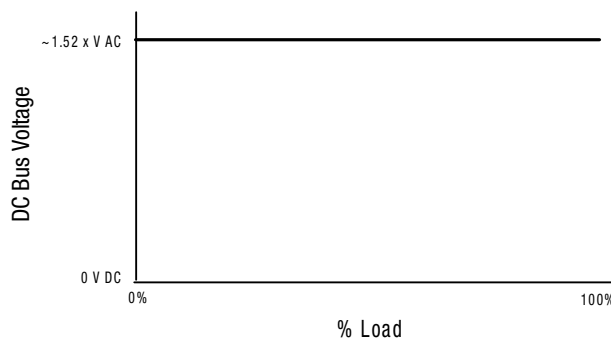


Output of RGU//RGU Configurations

In an RGU//RGU configuration, each RGU (when enabled) switches its IGBTs to maintain a constant voltage on the DC bus (which is typically 1.52 times the input voltage).

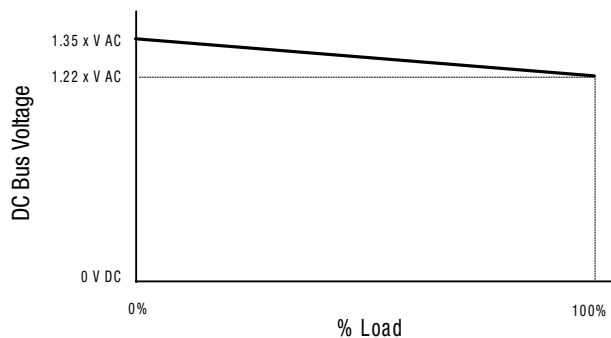
In this process, the master RGU evaluates the bus voltage and sends a current command (which is used to correct the bus voltage) to the slave RGUs. Each RGU switches its IGBTs to regulate the current (motoring or regenerative) needed to maintain the bus voltage.

Figure 1.5
RGU//RGU Bus Voltage—Motoring or Regenerating



When the RGUs are not enabled, power is supplied through the free-wheeling diodes. The diode bridge produces a voltage of 1.35 times the input voltage with no load, and decreases to 1.22 times the input voltage at full load. During this operation, the RGUs do not regulate the voltage or regenerate any current.

Figure 1.6
RGU//RGU Bus Voltage—Diode Bridge Operation (RGU Not Enabled)

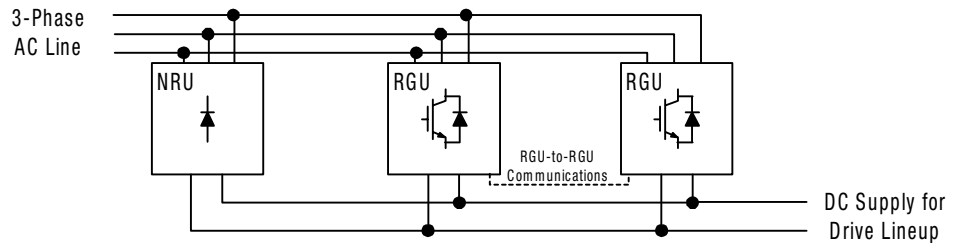


NRU//RGU Configurations

In the NRU//RGU configuration, the NRU is used to supply motoring current to the DC bus, while the RGUs are used to regenerate current to the AC line.

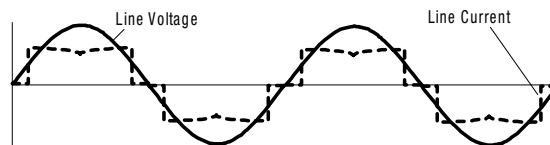
When motoring, the NRU operates to supply its maximum motoring current to the DC bus, and the RGUs operate to supply 10% of their maximum motoring current to the DC bus. When regenerating, the NRU's diode bridge stops operating, and the RGUs regenerate the current back onto the AC line.

Figure 1.7
NRU//RGU Configuration



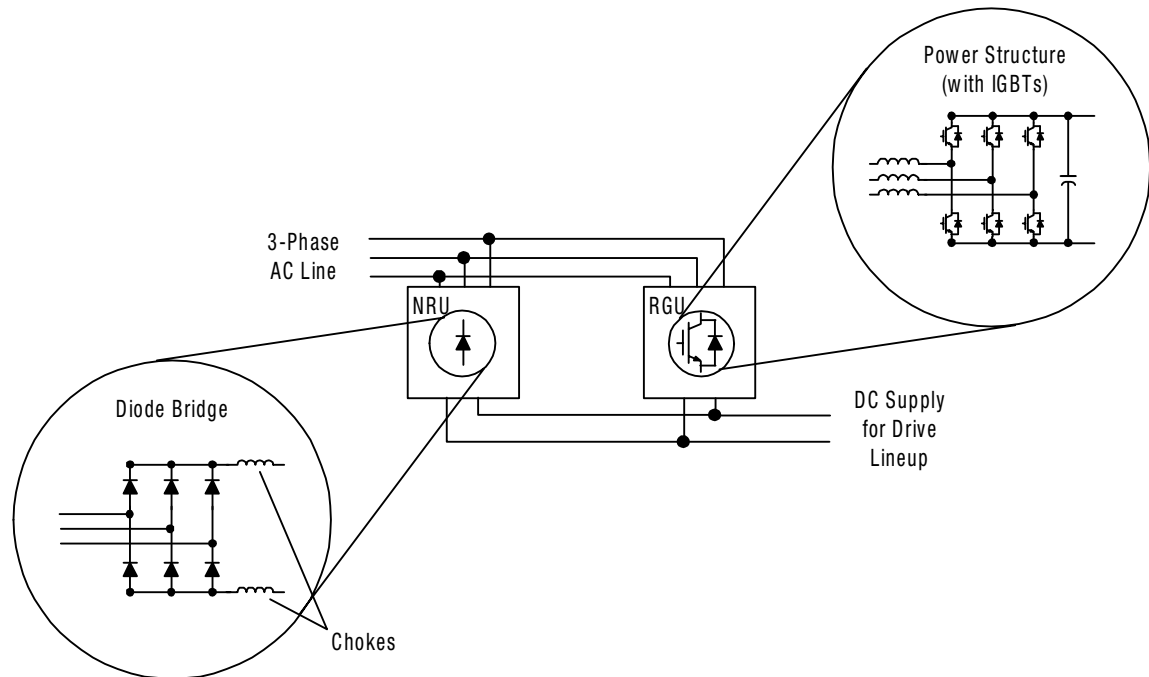
The NRU supplies motoring current through its diode bridge, and the RGU supplies motoring and regenerative current through its power structure.

Figure 1.8
Line Waveform—NRU//RGU Configuration



In the NRU//RGU configuration, the NRU has chokes on the DC bus. These chokes reduce circulating current between the RGU and NRU. If a slave RGU is in the configuration, the slave RGU will have a common mode choke installed on its AC line.

Figure 1.9
NRU//RGU Configuration—Basic Components

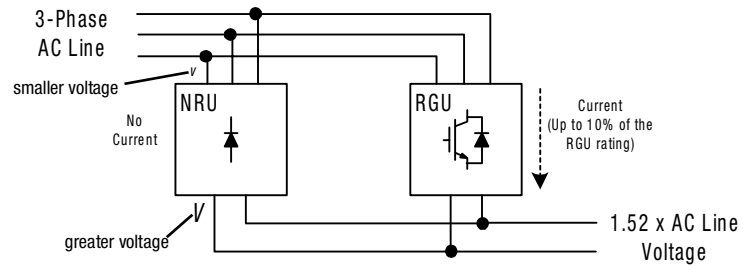


The RGU evaluates the bus voltage and adjusts its current to maintain the nominal bus voltage. If there are two RGUs in the configuration, the master RGU evaluates the voltage and sends current commands to the slave RGU, and both RGUs will switch their IGBTs to regulate the necessary current on the DC bus.

Output of NRU/RGU Configurations

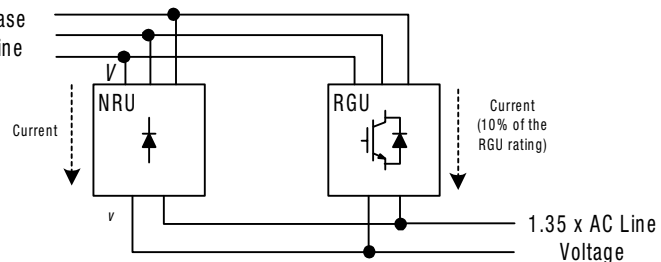
The RGUs supply up to 10% of their rated amperes as motoring current. In this first 10%, the RGUs will regulate the voltage to 1.52 times the line voltage, the voltage on the DC bus will be greater than the AC line, and the diodes in the NRU will not conduct.

Figure 1.10
RGU Motoring—Load Up To 10% of RGU Rating



When the load increases beyond the first 10%, the RGU is no longer able to regulate the voltage (since the current limit is set to 10%), and the bus voltage drops to a level where the diodes in the NRU can conduct. The NRU then supplies the motoring current for the remainder of the load, resulting in a bus voltage of 1.35 times the line voltage.

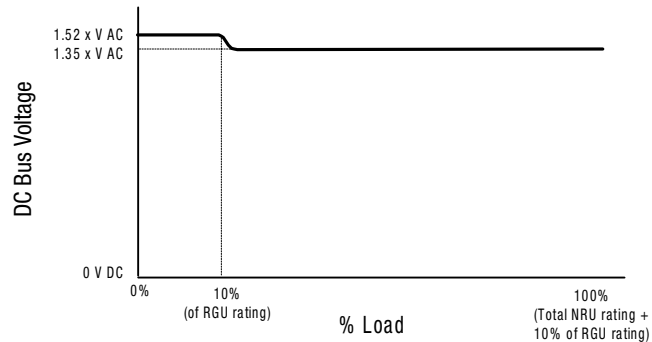
Figure 1.11
RGU and NRU Motoring—Load Over 10% of RGU Rating



When the load drops under the 10% capability of the RGUs, the RGUs will begin to regulate the bus voltage again to 1.52 times the line voltage, and the diodes in the NRU will stop conducting.

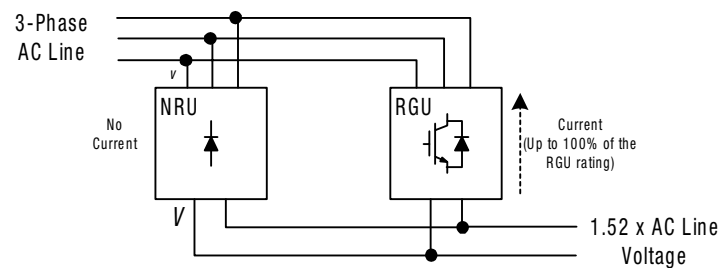
The diagram below shows the NRU//RGU motoring bus voltage. The RGUs regulate the bus voltage for the first 10% of the rated current for the RGUs, then the NRUs supply current for the remainder of the load (while the RGU current is limited to 10% of the RGU rating).

Figure 1.12
NRU//RGU Bus Voltage—Motoring



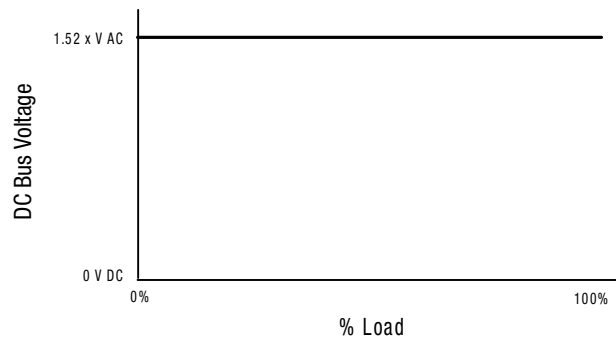
When the load is under 10% of the maximum motoring current, the RGUs can regulate (or maintain) the bus voltage. The RGU (master RGU) will evaluate the voltage on the bus, and will calculate the current needed to maintain the bus voltage. If a regenerative current is needed to maintain the voltage, the RGUs will begin switching their IGBTs to regenerate current onto the AC line. The diodes in the NRU will still not conduct current.

Figure 1.13
RGU Regenerating



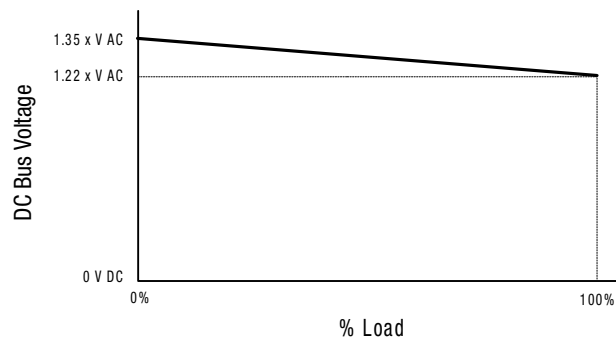
The diagram below shows the NRU//RGU regenerative bus voltage. The RGUs regenerate up to 100% of their rated current to the AC line while the NRU diode bridge stops conducting.

Figure 1.14
NRU//RGU Bus Voltage—Regenerating



When the RGUs are not enabled, only the NRU supplies current to the DC bus. The bus voltage is 1.35 times the line voltage at no load, and decreases to 1.22 times the line voltage at full load. During this operation, the RGUs do not regulate the voltage or regenerate any current.

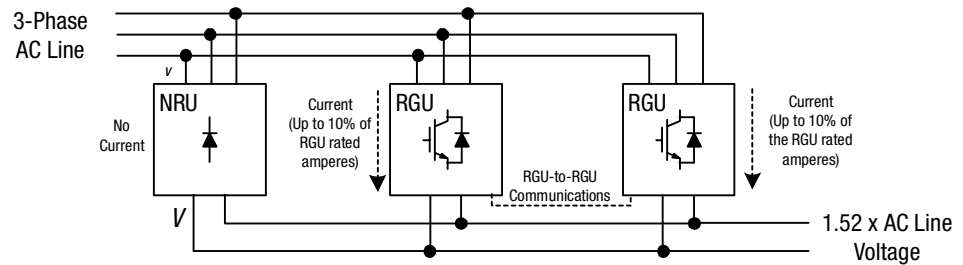
Figure 1.15
NRU//RGU Bus Voltage—RGUs Not Enabled



If there are two RGUs in the configuration, each RGU will supply up to 10% of its rated motoring current. If the load is in this 10%, the RGUs will regulate the bus voltage. The master RGU will evaluate the bus voltage, and will determine the current required to maintain the nominal bus voltage (1.52 times the line voltage). The master RGU will send a current command to the slave RGU, and both RGUs will begin switching their IGBTs to provide the proper motoring or regenerative current.

Figure 1.16
NRU With Two RGUs—Motoring

Motoring - Up to 10% of RGU Rated Amperes



Motoring - Over 10% of RGU Rated Amperes

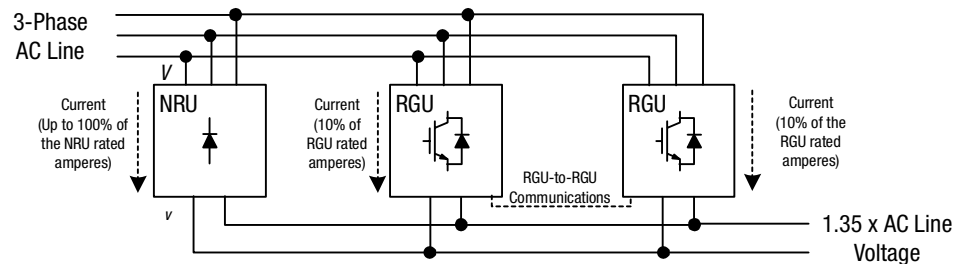
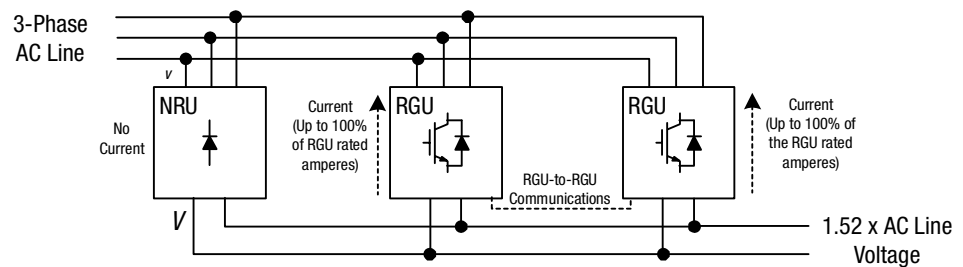


Figure 1.17
NRU With Two RGUs—Regenerating



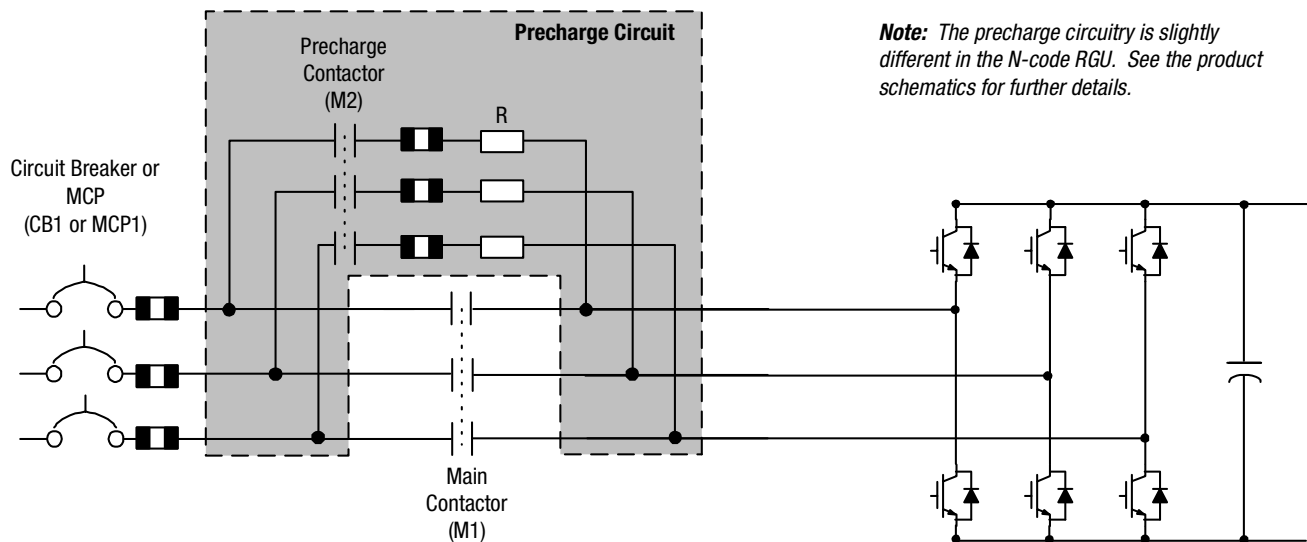
Precharge Operation

When the disconnects are closed and the start switch is turned on, each RGU in the parallel configuration will begin its precharge routine. This routine charges the capacitors on the DC bus (the RGU capacitor bank and inverter capacitors) in a controlled fashion.

Two contactors (M1 and M2) are used to perform the precharge operation in the K, L, and M-code RGUs (the N-code RGU precharge circuit is slightly different).

When the disconnect (MCP1 or CB1) is closed and the start switch is turned on, the main contactor (M1) remains open, the precharge contactor (M2) closes, and current begins to flow through the precharge circuit (bypassing the main 3-phase circuit). This precharge circuit (which has a resistive load) charges up the capacitor bank. As the bank approaches capacity, the main contactor (M1) closes, the precharge contactor (M2) opens, the NRU circuit breaker closes, and normal operation begins.

Figure 1.18
Precharge Circuit

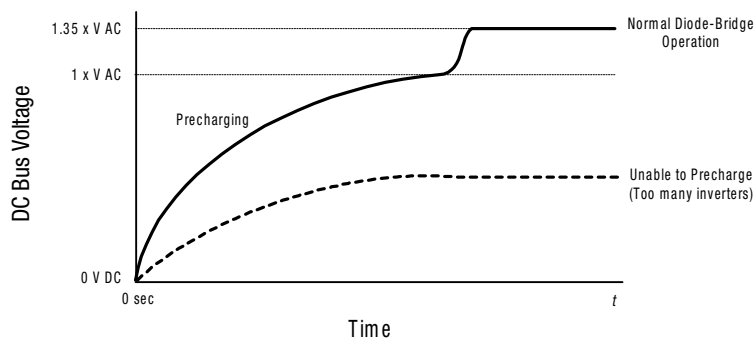


The RGUs will precharge the capacitors on the bus until the bus voltage rises to be equal to the line voltage. Then, the precharge circuit will open, the main circuit will close, the NRU circuit breaker will close, and the DC bus voltage will rise to 1.35 times the line voltage.



ATTENTION: If there is too much capacitance on the DC bus, the RGUs may not be able to raise the bus voltage to the threshold for normal operation, resulting in damage to equipment.

Figure 1.19
Precharge Voltage



R1 and S1-Code Parallel Configurations

R1-Code Parallel Configuration

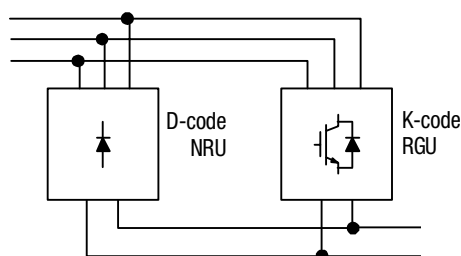
The R1-code parallel configuration is a common DC bus front-end unit consisting of an D-code NRU in parallel with a K-code RGU.

Figure 2.1
R1-Code Parallel Configuration—Information

R1-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	1520	780
460	1520	944
575	1520	1180

R1-code Parallel Configuration



S1-Code Parallel Configuration

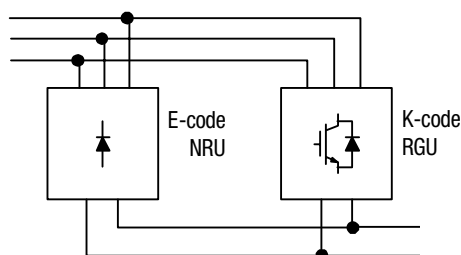
The S1-code parallel configuration is a common DC bus front-end unit consisting of an E-code NRU in parallel with a K-code RGU.

Figure 2.2
S1-Code Parallel Configuration—Information

S1-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2020	1036
460	2020	1254
575	2020	1568

S1-code Parallel Configuration

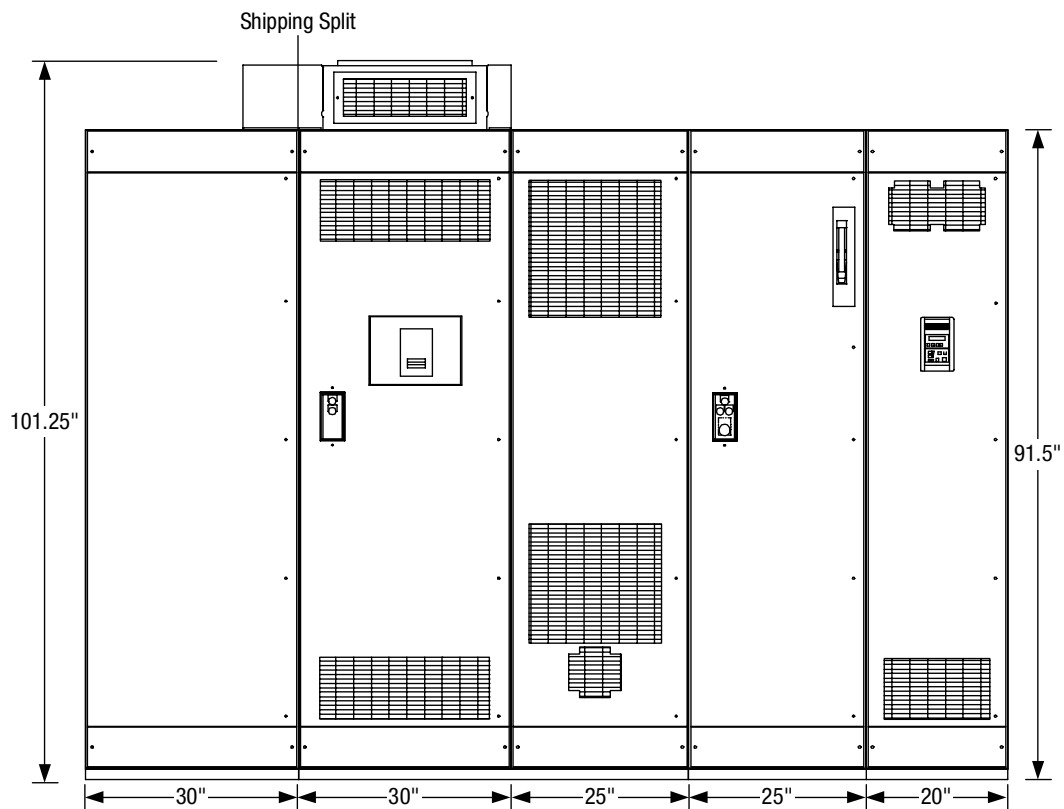


Note: Information for the D-code NRU and E-code NRU can be found in publication 2364E-5.01. Information for the K-code RGU can be found in publication 2364F-5.01.

Component Layout

Figure 2.3
Enclosure Layout

Front View



Cutaway View

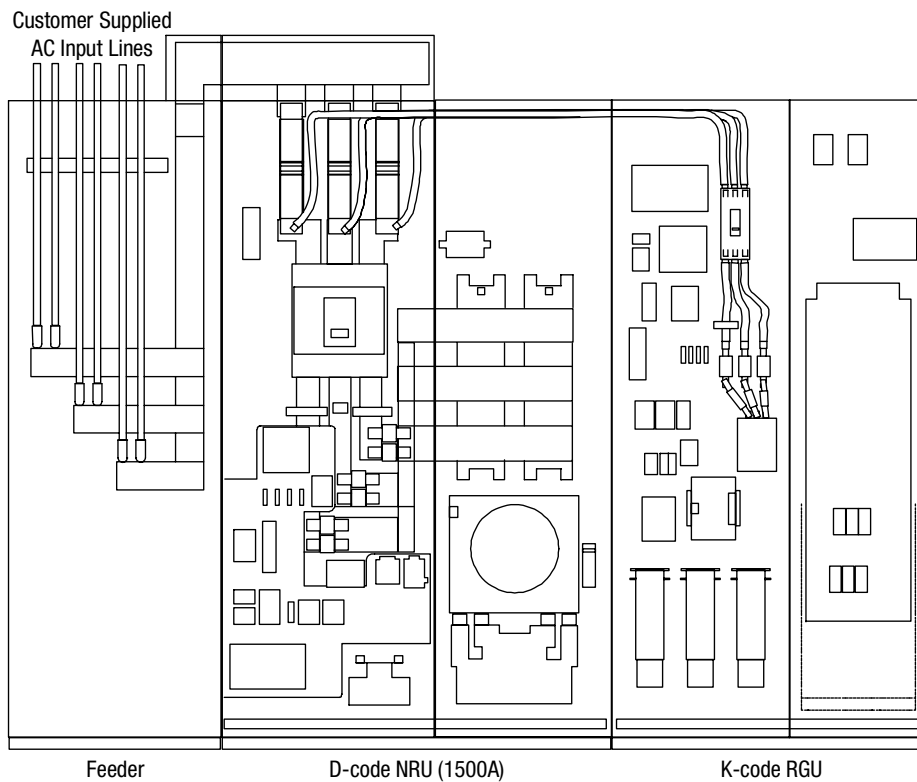
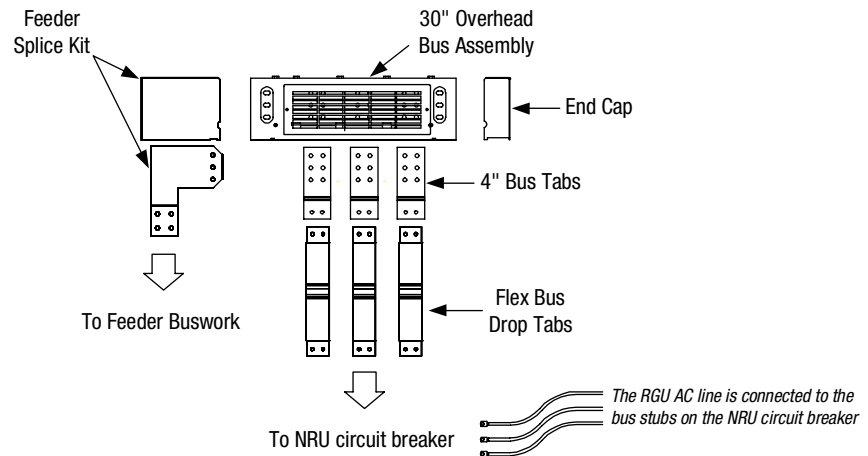


Figure 2.4
Overhead Bus Assembly



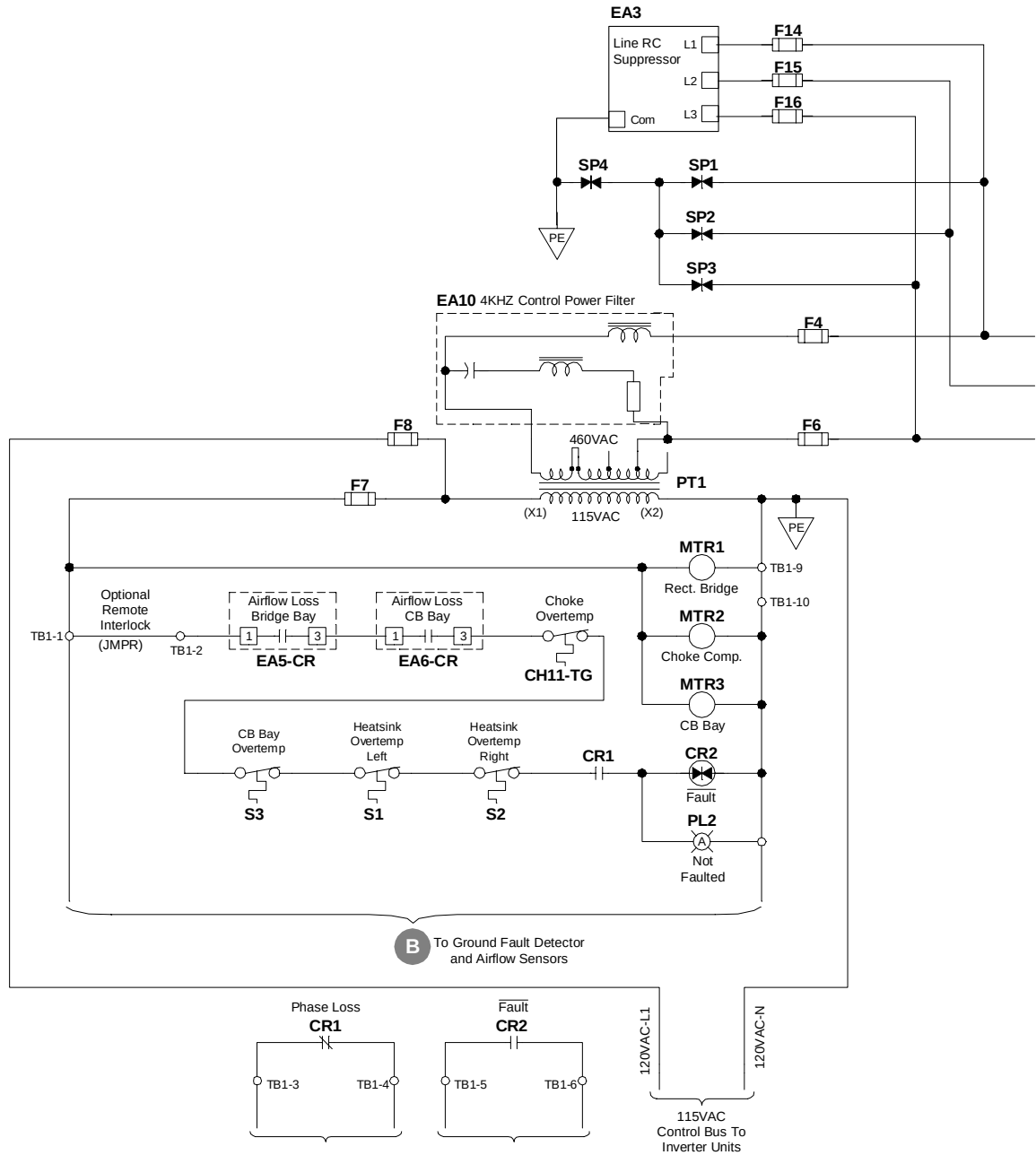
New and Revised NRU and RGU Components in the R1 and S1 Configurations

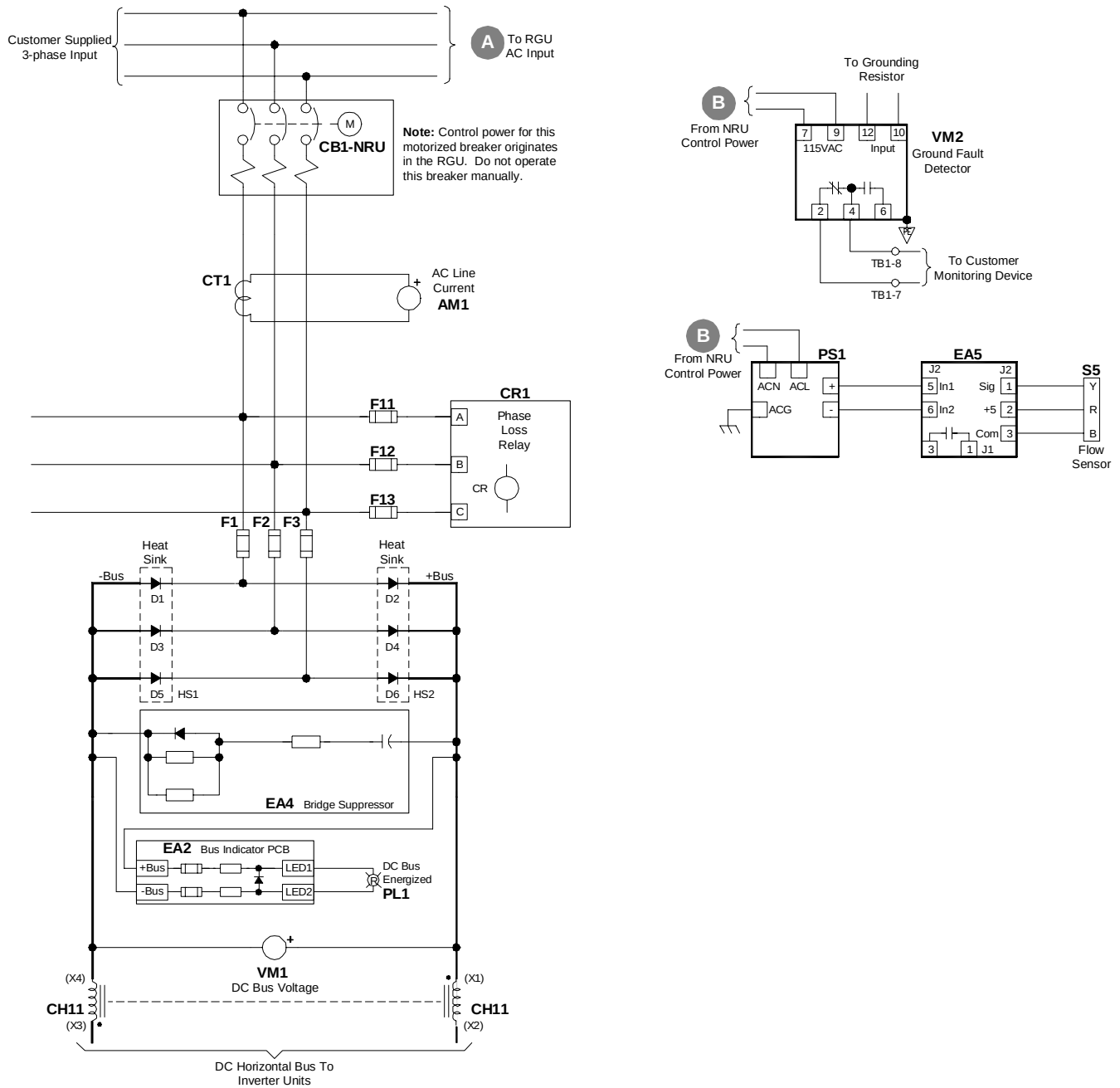
NRU	CB1	2000A, RD-frame with motor operator, aux contact (2NO/2NC)	
	EA10	Control power filter, 4kHz	
	F4, F6	Primary fuse for 5kVA control transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	
	TB10	Control power transformer, 10kVA (Opt 6P)	
		Control terminal block, 30A, 600V	
RGU	CR4	Precharge Lockout Relay (2NO/2NC)	
	F4, F6	Primary fuse for 2kVA transformer	
		10A, KLDR (for 380V AC input)	
		9A, KLDR (for 460V AC input)	
		8A, KLDR (for 575V AC input)	
	F21, F22	DC bus fuses, 250A, 700V, 170M	
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 2kVA	
	TR1	Timer relay (3NO/1NC)	
		TB4	Control Terminal block, 30A, 600V
		Overhead bus assembly	

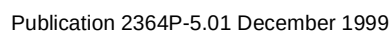
Schematics

Figure 2.5
Schematics

NRU





RGU

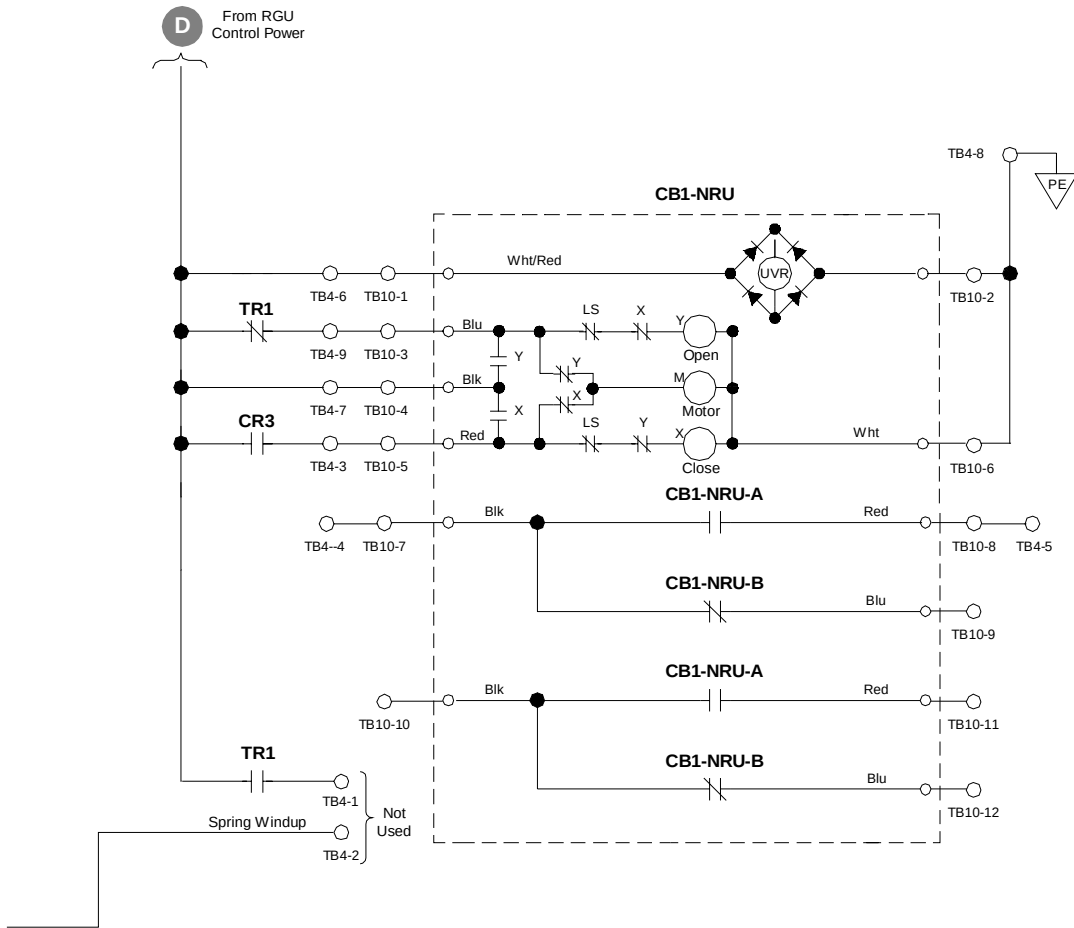
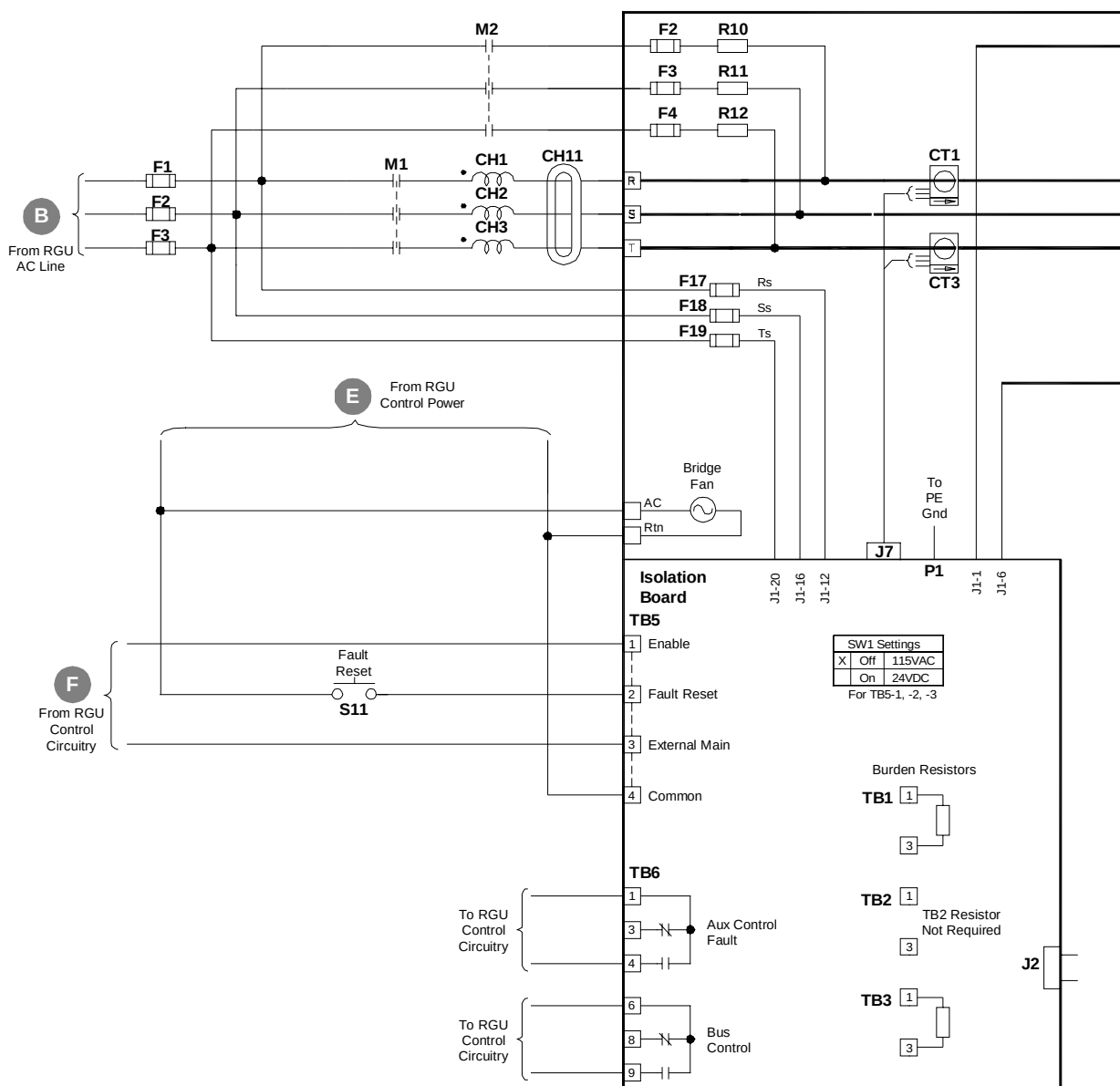
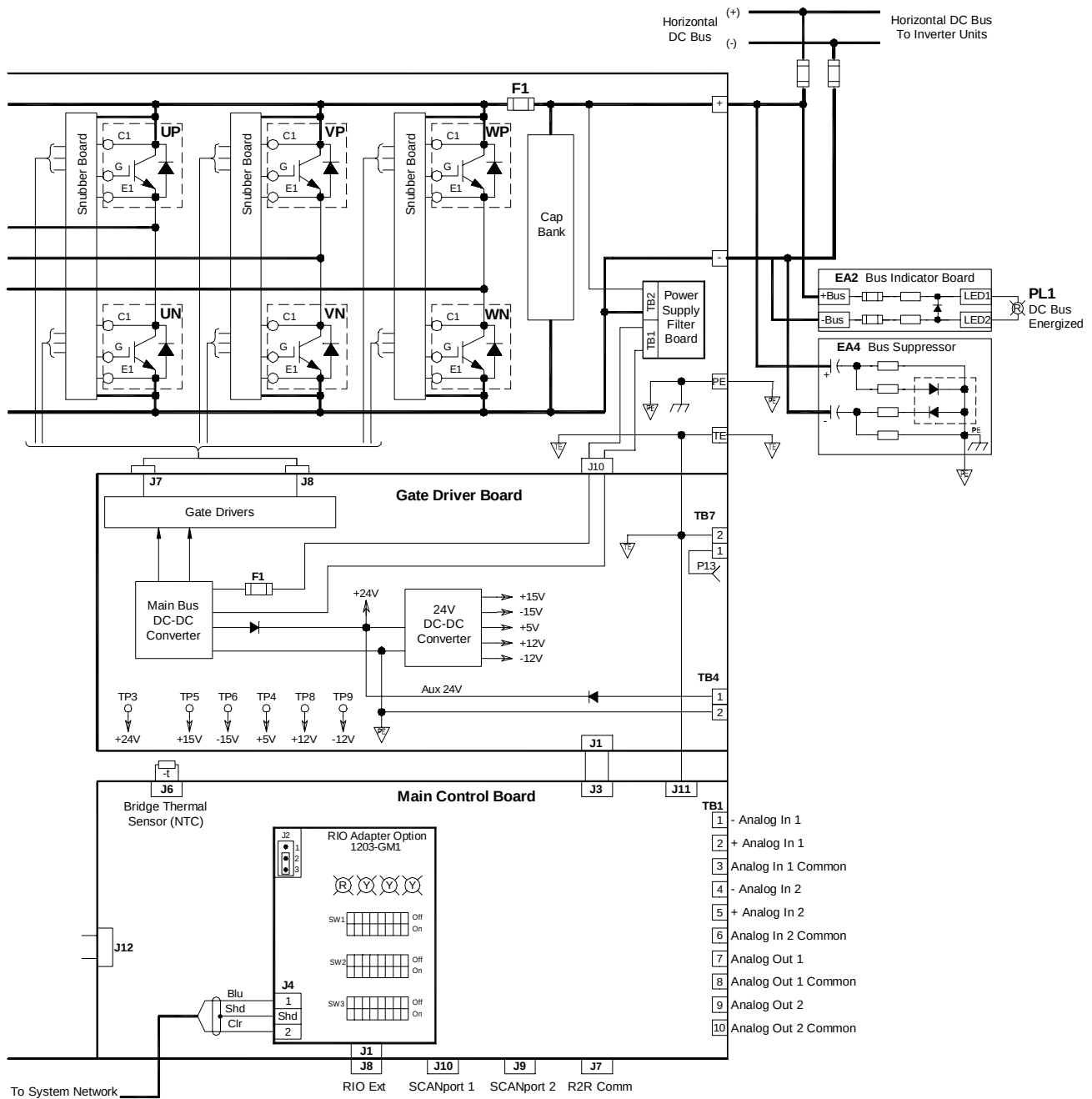


Figure 2.7
Schematics (cont.)





R2 and S2-Code Parallel Configurations

R2-Code Parallel Configuration

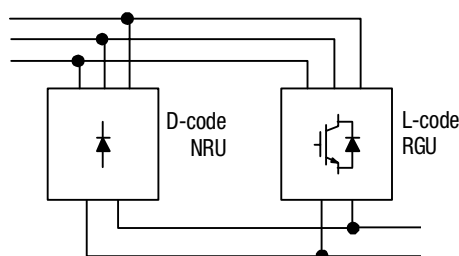
The R2-code parallel configuration is a common DC bus front-end unit consisting of an D-code NRU in parallel with a L-code RGU.

Figure 3.1
R2-Code Parallel Configuration—Information

R2-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	1536	788
460	1536	954
575	1533	1190

R2-code Parallel Configuration



S2-Code Parallel Configuration

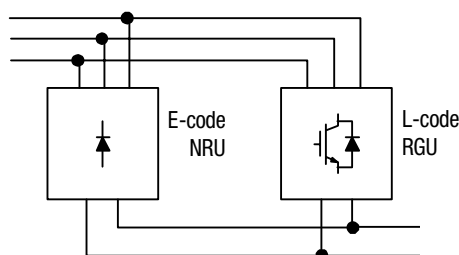
The S2-code parallel configuration is a common DC bus front-end unit consisting of an E-code NRU in parallel with a L-code RGU.

Figure 3.2
S2-Code Parallel Configuration—Information

S2-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2036	1045
460	2036	1265
575	2033	1578

S2-code Parallel Configuration

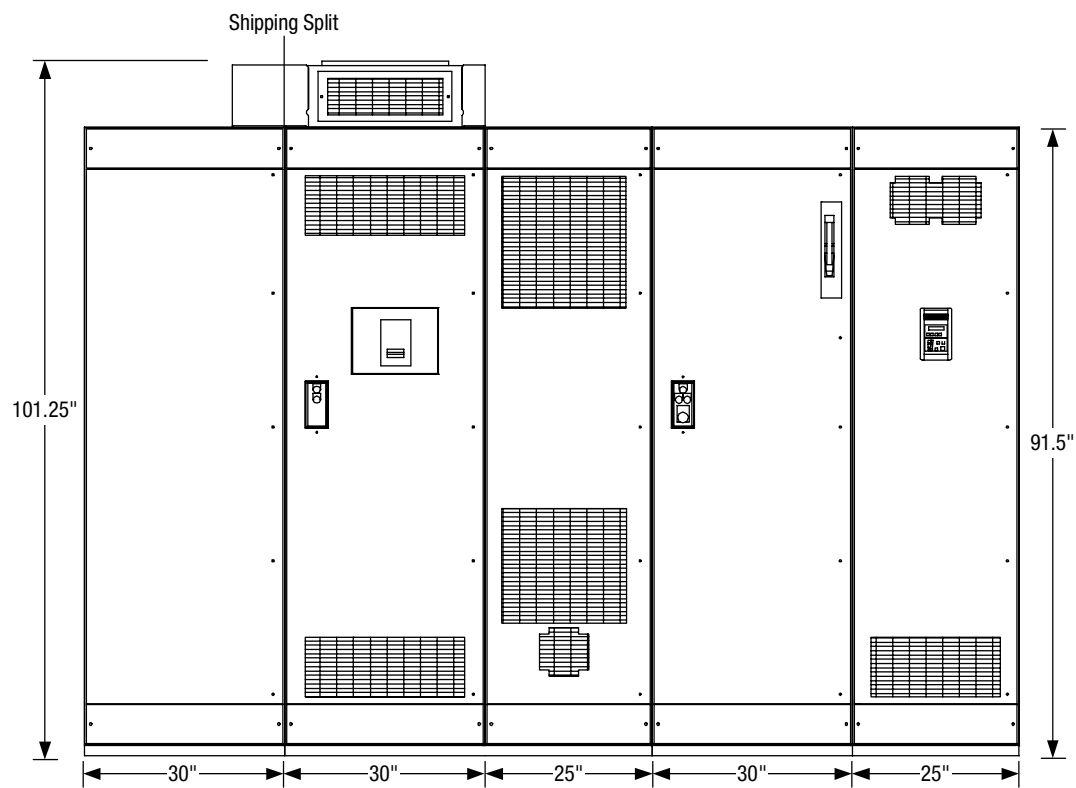


Note: Information for the D-code NRU and E-code NRU can be found in publication 2364E-5.01. Information for the L-code RGU can be found in publication 2364F-5.01.

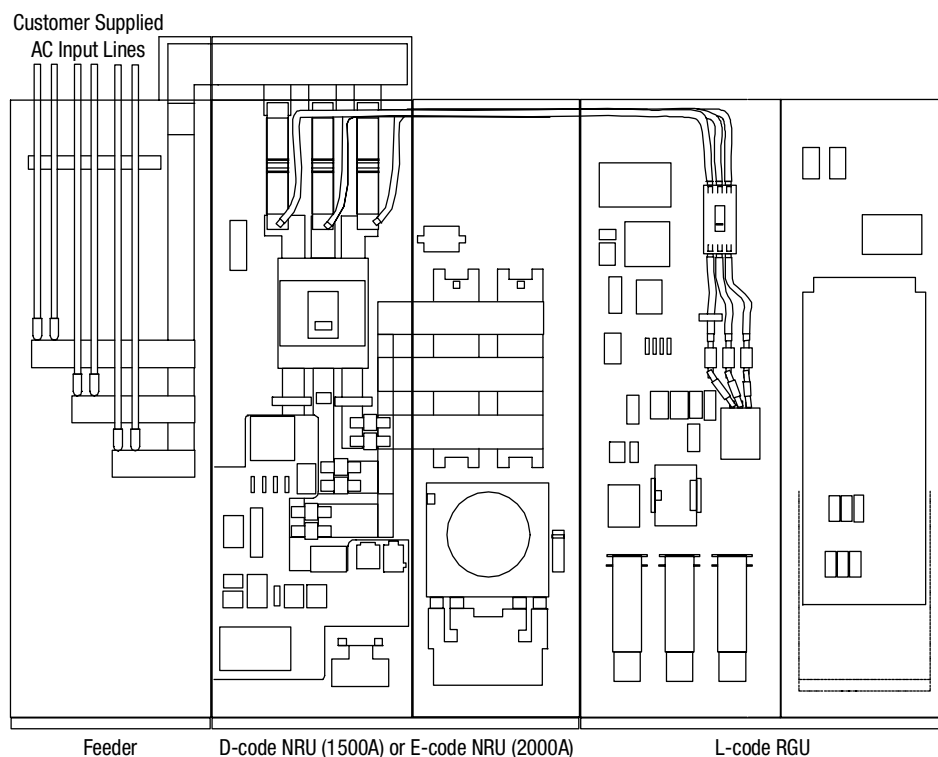
Component Layout

Figure 3.3
Enclosure Layout

Front View

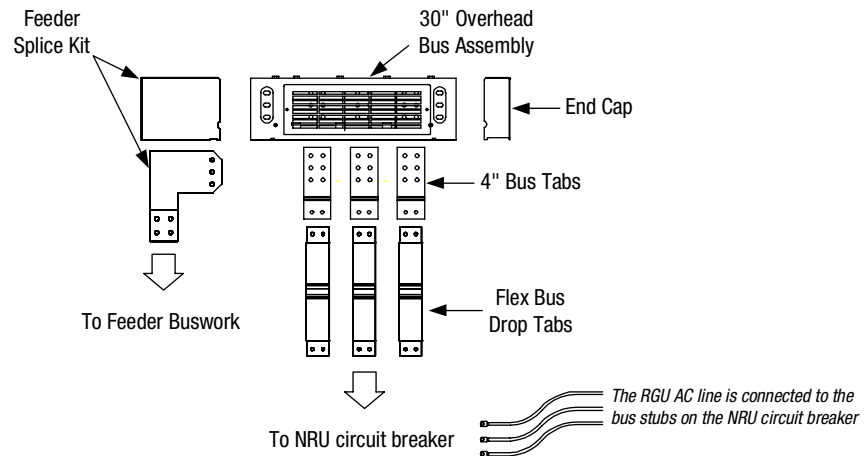


Cutaway View



Note: The D-code NRU has only one AC line fuse per phase.

Figure 3.4
Overhead Bus Assembly



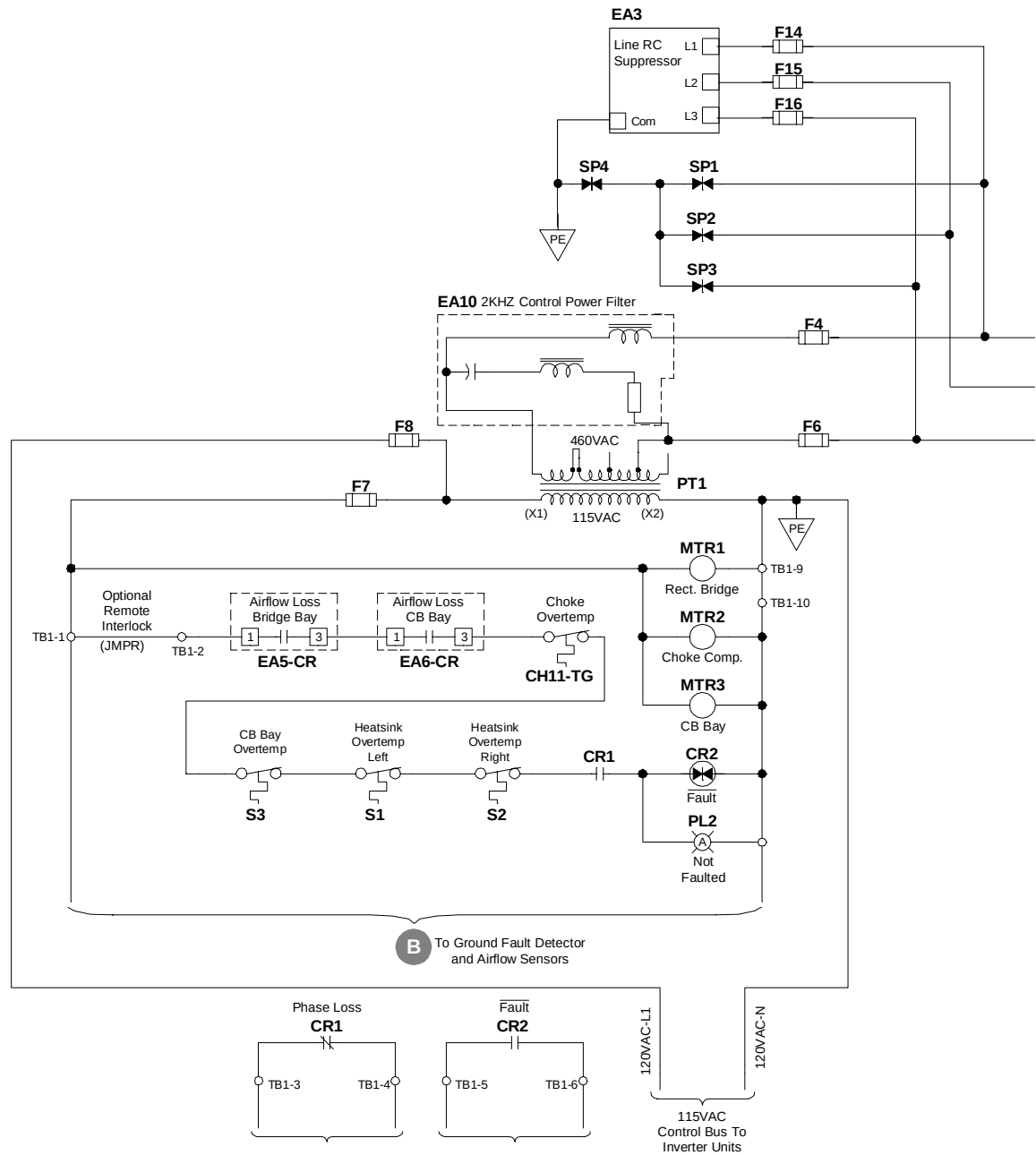
New and Revised NRU and RGU Components in the R2 and S2 Configurations

NRU	CB1	2000A, RD-frame with motor operator, aux contact (2NO/2NC)	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	
	TB10	Control power transformer, 10kVA (Opt 6P)	
		Control terminal block, 30A, 600V	
RGU	CR4	Precharge Lockout Relay (2NO/2NC)	
	F4, F6	Primary fuse for 5kVA transformer	
		25A, KLDR (for 380V AC input)	
		20A, KLDR (for 460V AC input)	
		17.5A, KLDR (for 575V AC input)	
	F21, F22	DC bus fuses, 500A, 700V, 170M	
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
		TB4	Control Terminal block, 30A, 600V
		Overhead bus assembly	

Schematics

Figure 3.5
Schematics

NRU



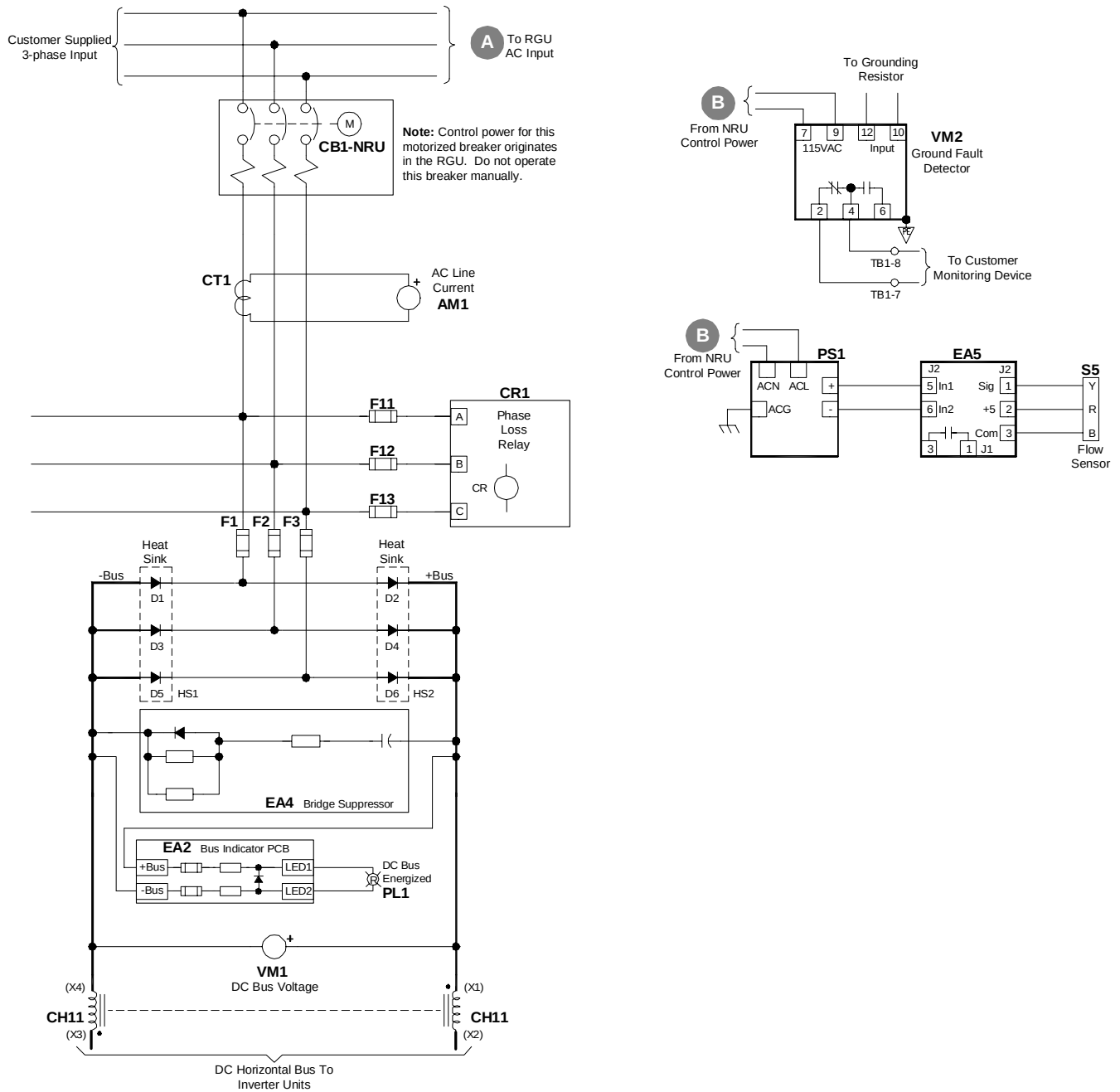
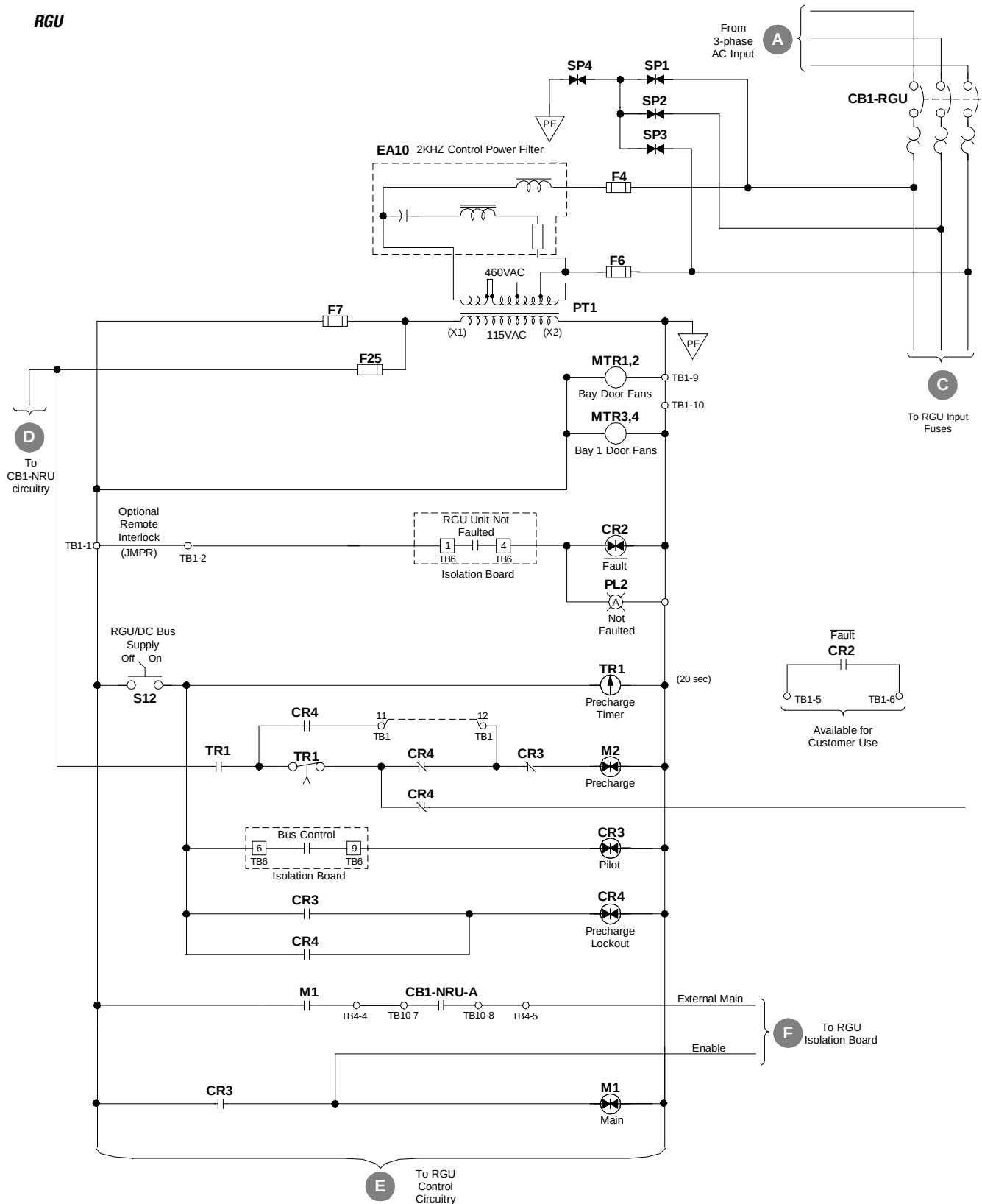


Figure 3.6
Schematics (cont.)

RGU



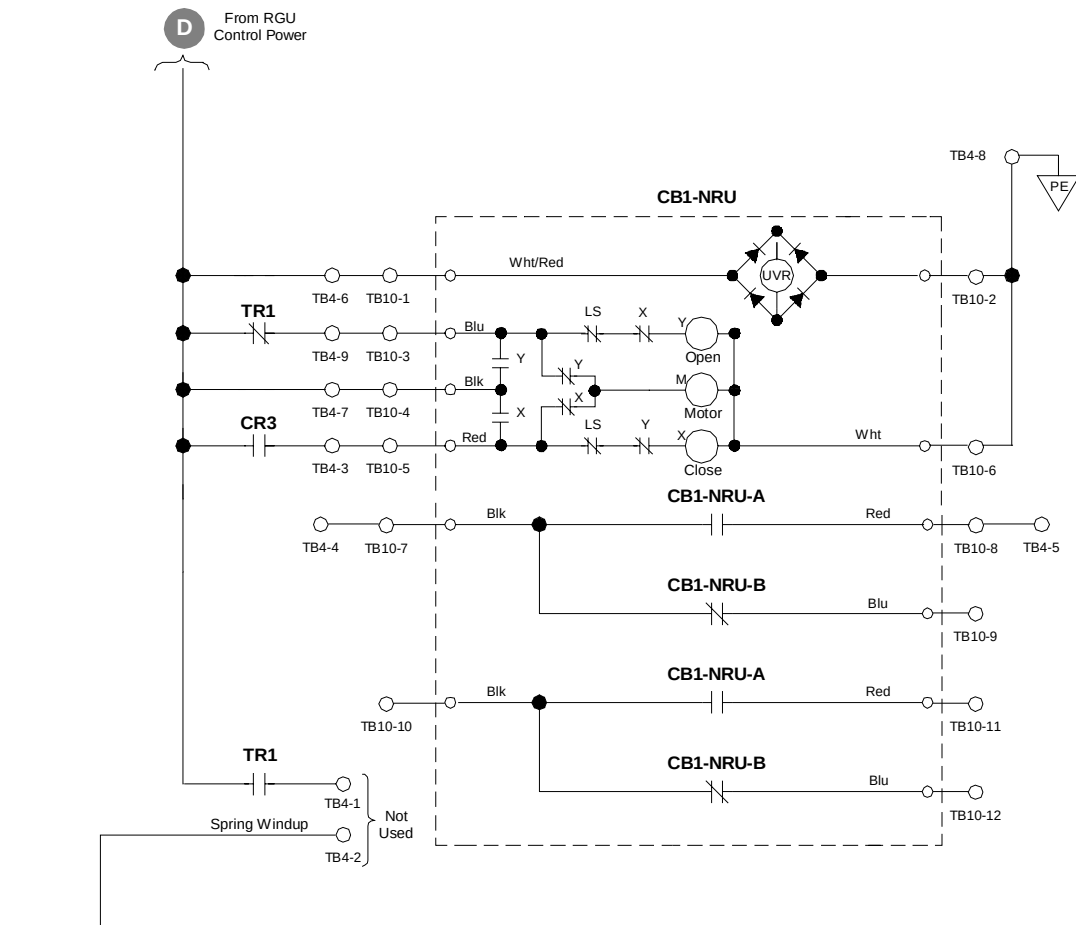
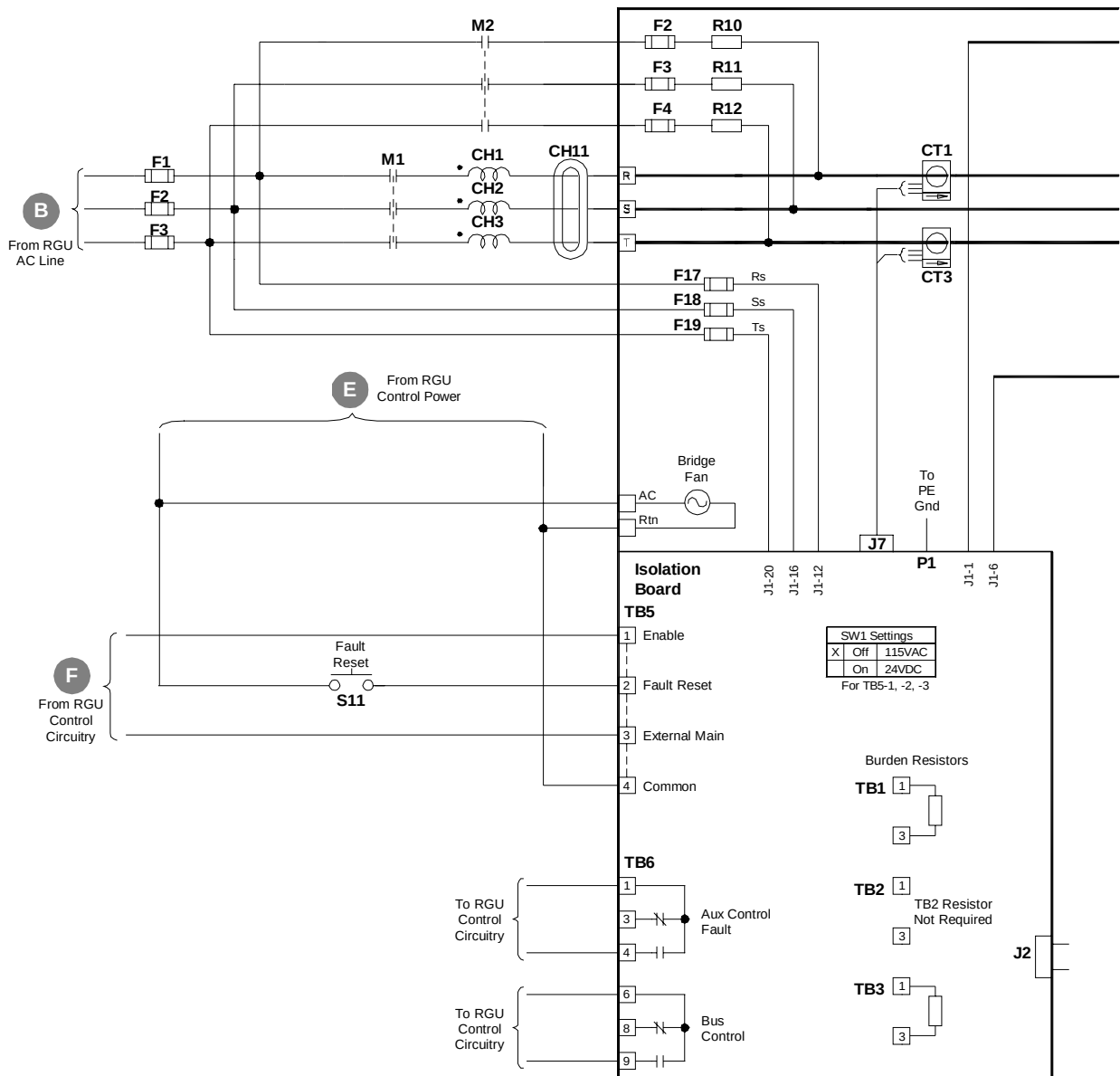
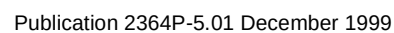


Figure 3.7
Schematics (cont.)





R3 and S3-Code Parallel Configurations

R3-Code Parallel Configuration

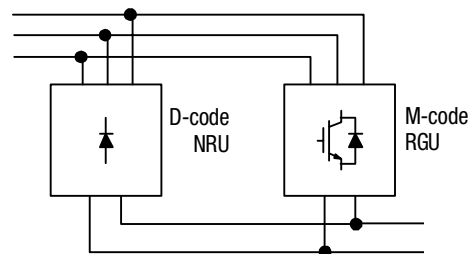
The R3-code parallel configuration is a common DC bus front-end unit consisting of an D-code NRU in parallel with an M-code RGU.

Figure 4.1
R3-Code Parallel Configuration—Information

R3-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	1575	808
460	1575	978
575	1569	1218

R3-code Parallel Configuration



S3-Code Parallel Configuration

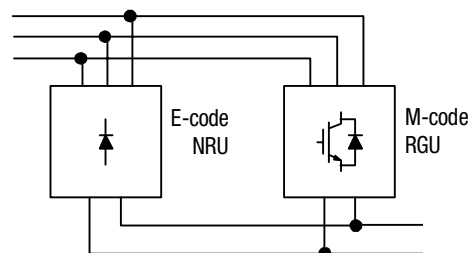
The S3-code parallel configuration is a common DC bus front-end unit consisting of an E-code NRU in parallel with an M-code RGU.

Figure 4.2
S3-Code Parallel Configuration—Information

S3-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2075	1064
460	2075	1289
575	2069	1606

S3-code Parallel Configuration

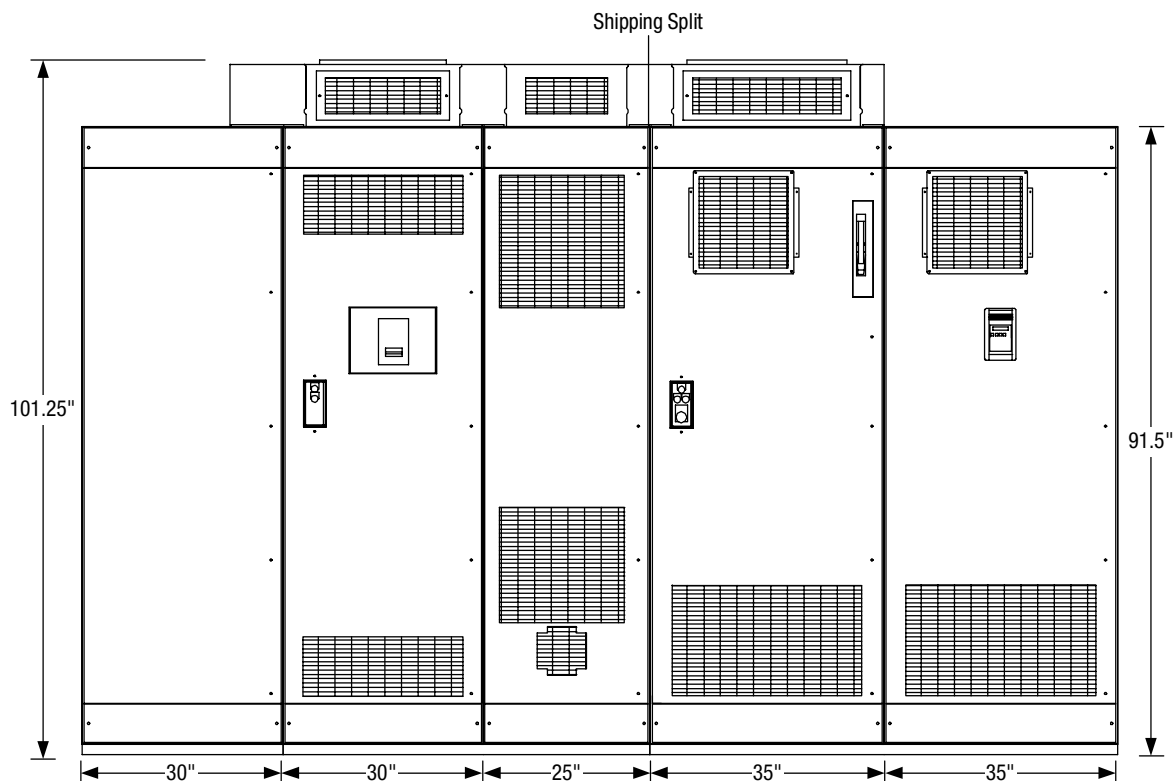


Note: Information for the D-code NRU and E-code NRU can be found in publication 2364E-5.01. Information for the M-code RGU can be found in publication 2364F-5.01.

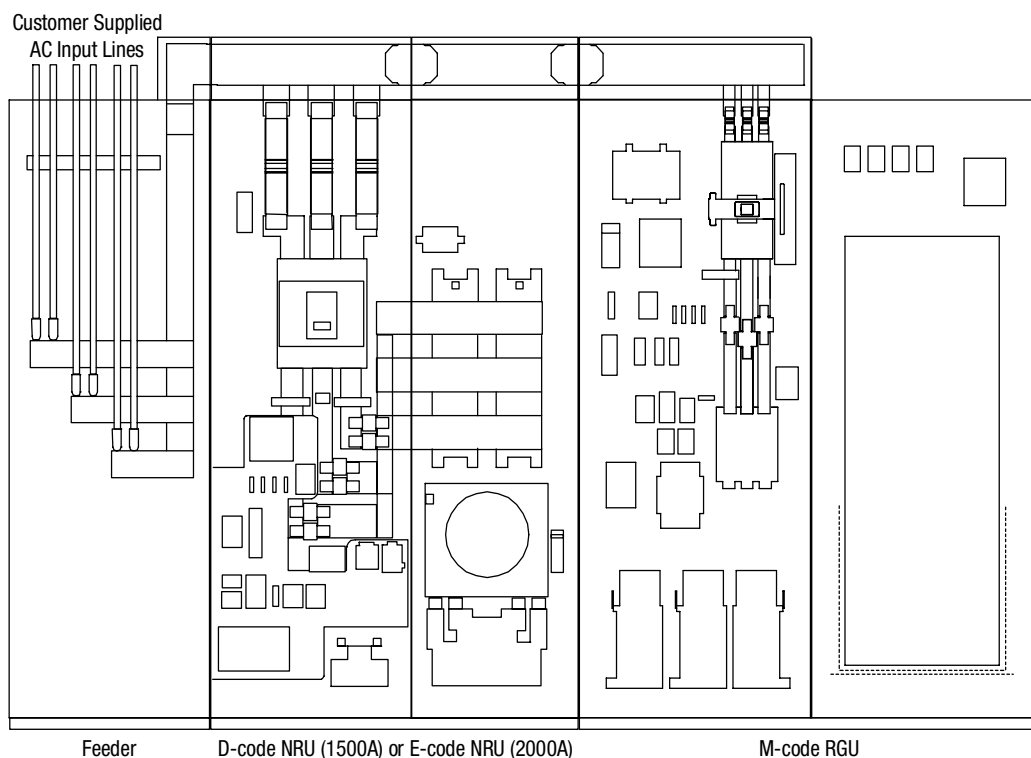
Component Layout

Figure 4.3
Enclosure Layout

Front View

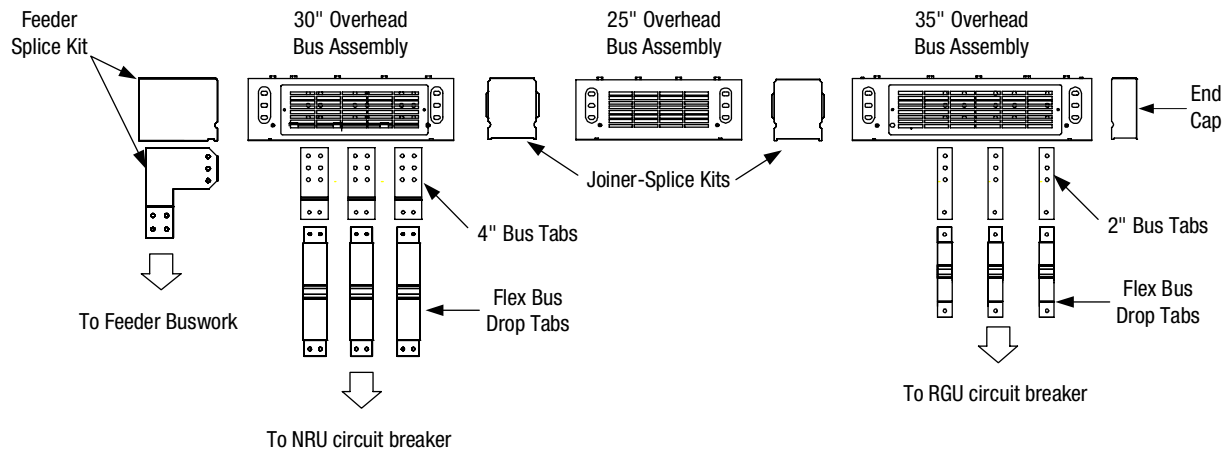


Cutaway View



Note:
The D-code NRU has only
one AC line fuse per phase.

Figure 4.4
Overhead Bus Assembly



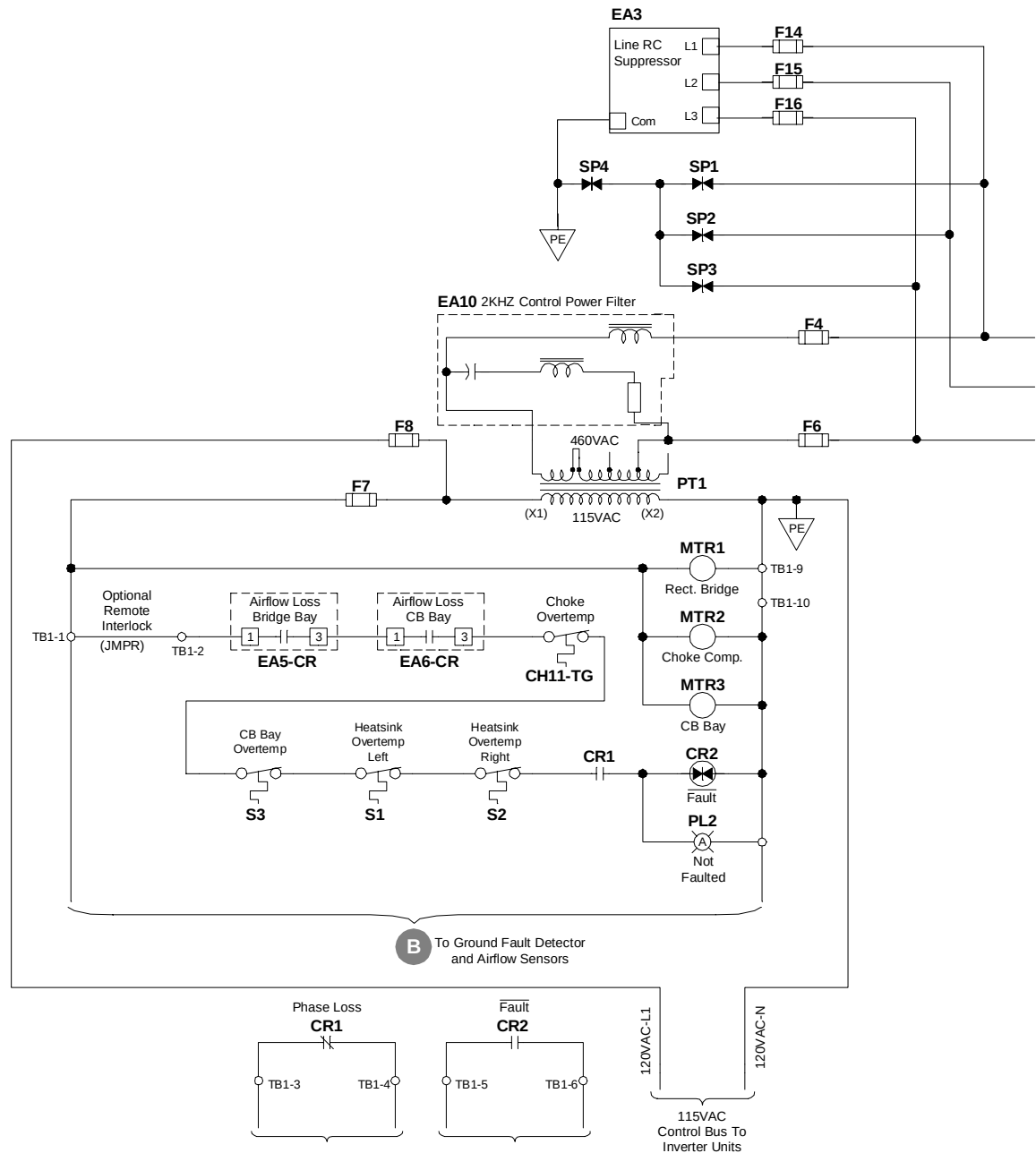
New and Revised NRU and RGU Components in the R3 and S3 Configurations

NRU	CB1	2000A, RD-frame with motor operator, aux contact (2NO/2NC)	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	
	TB10	Control power transformer, 10kVA (Opt 6P)	
		Control terminal block, 30A, 600V	
RGU	CR4	Precharge Lockout Relay (2NO/2NC)	
	F4, F6	Primary fuse for 5kVA transformer	
		25A, KLDR (for 380V AC input)	
		20A, KLDR (for 460V AC input)	
		17.5A, KLDR (for 575V AC input)	
	F21, F22	DC bus fuses, 500A, 700V, 170M	
	21A, 22A		
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
		Overhead bus assembly	

Schematics

Figure 4.5
Schematics

NRU



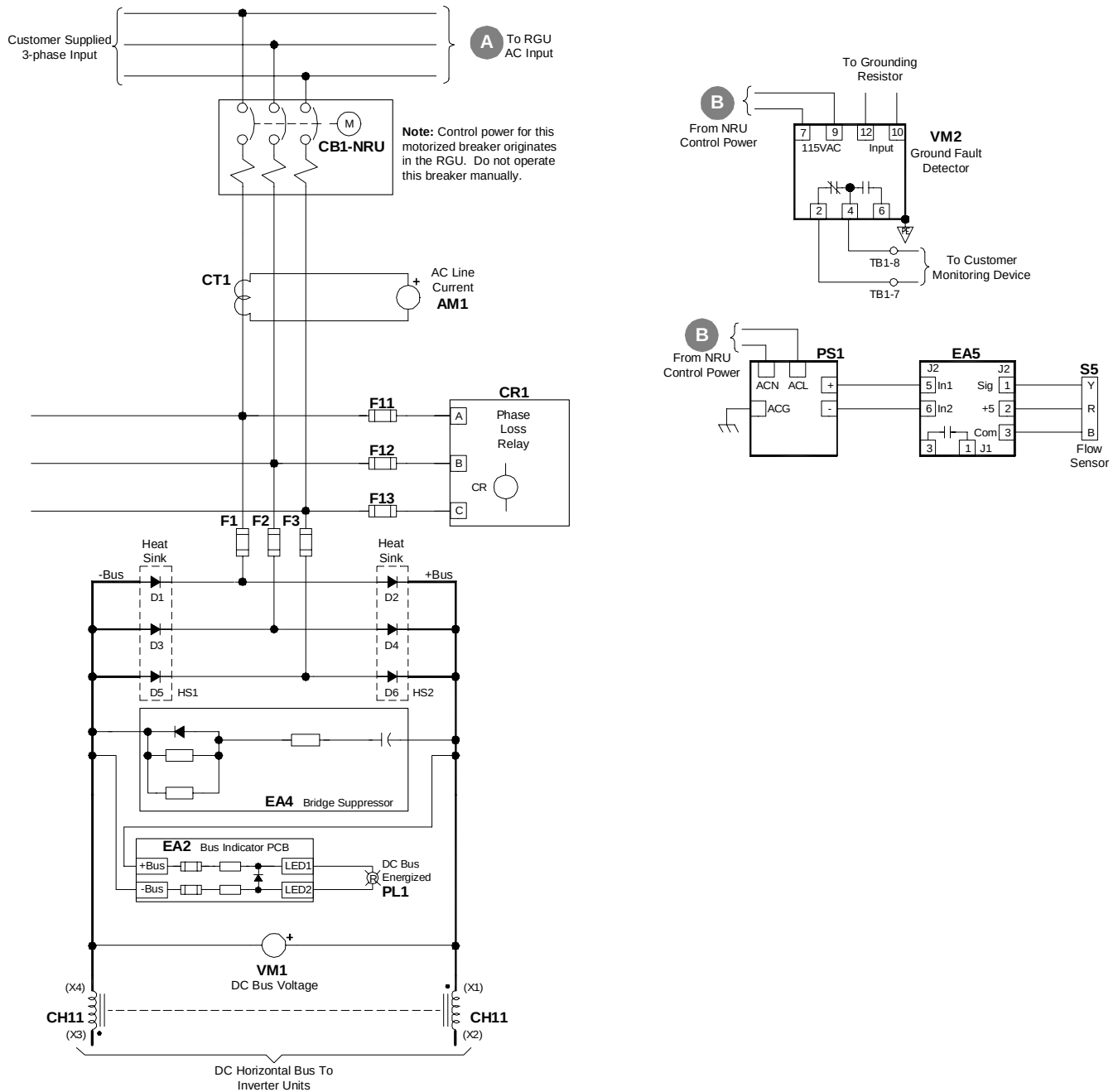
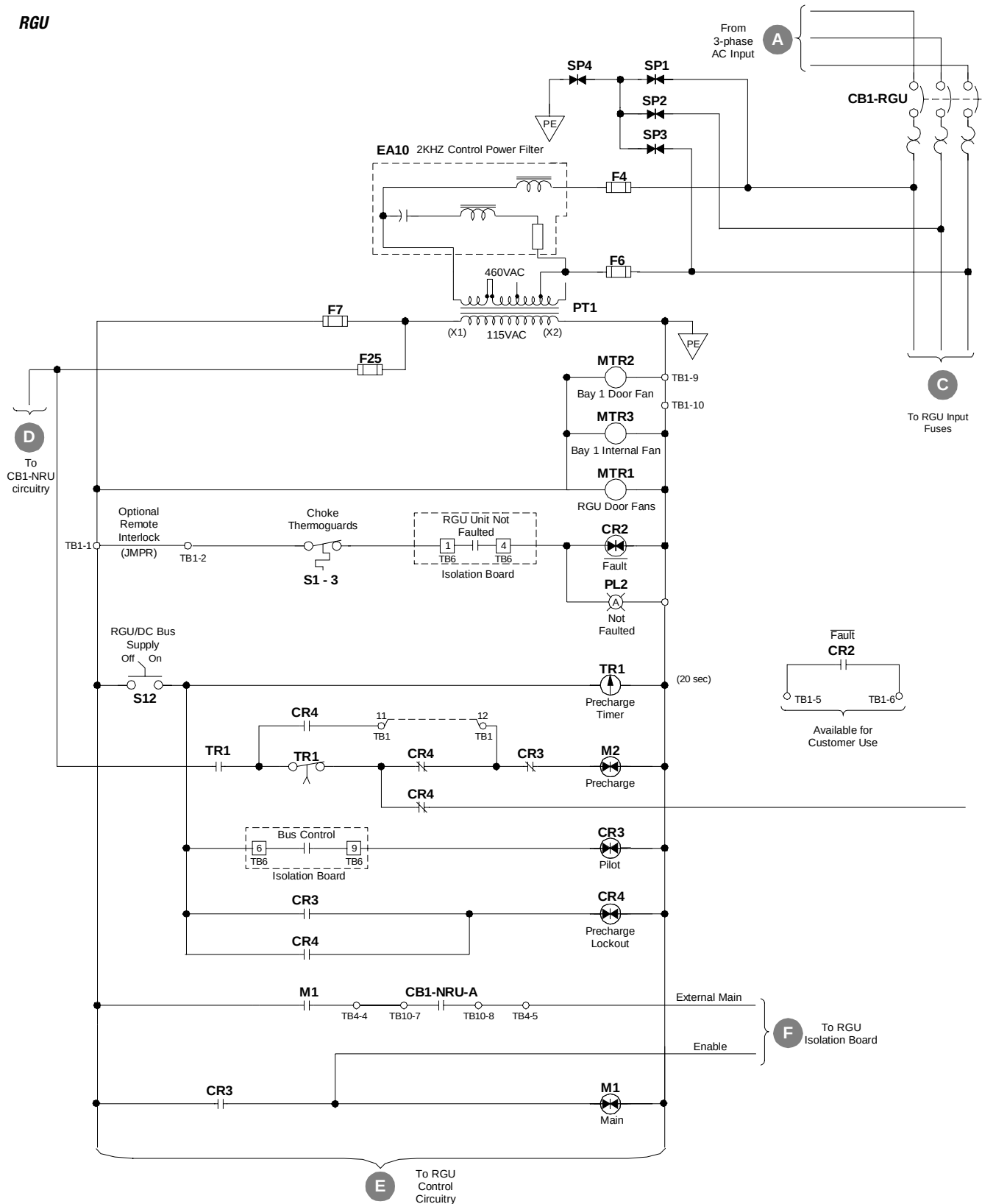


Figure 4.6
Schematics (cont.)

RGU

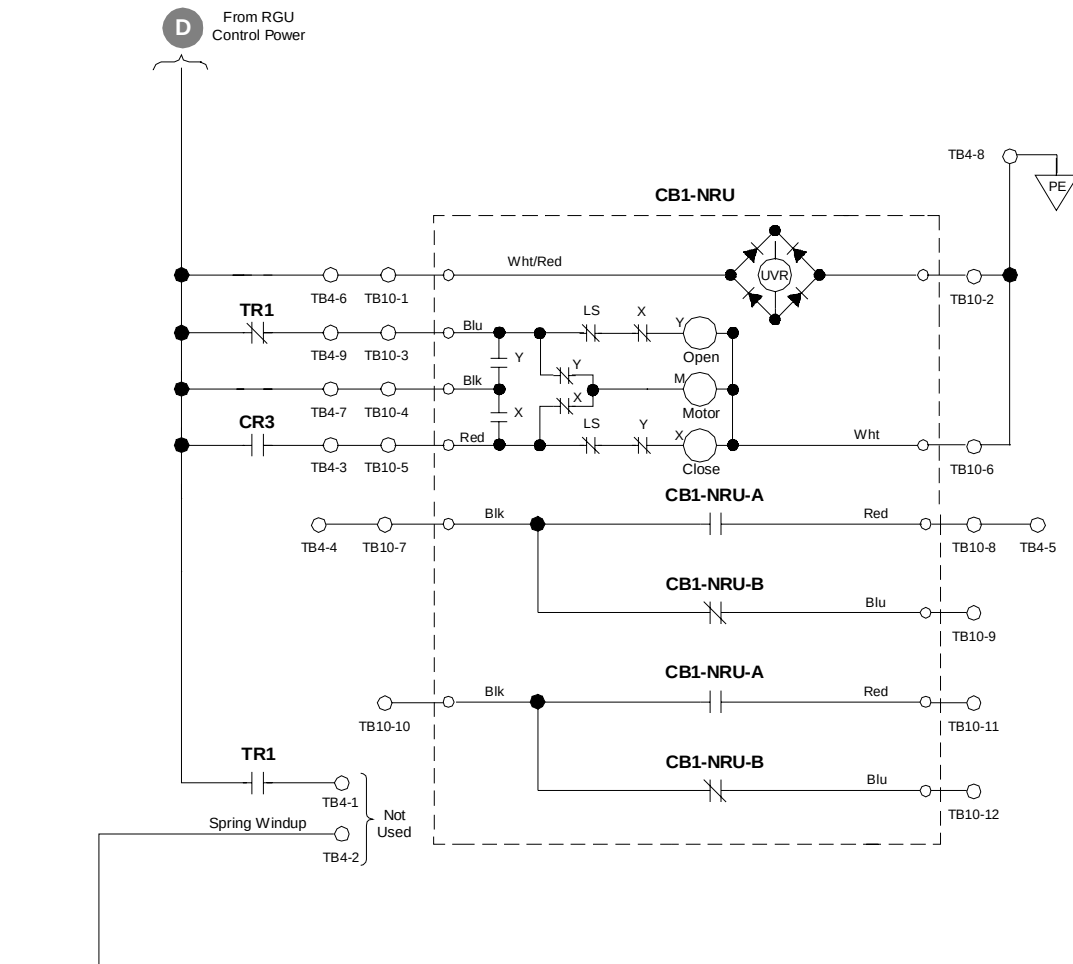
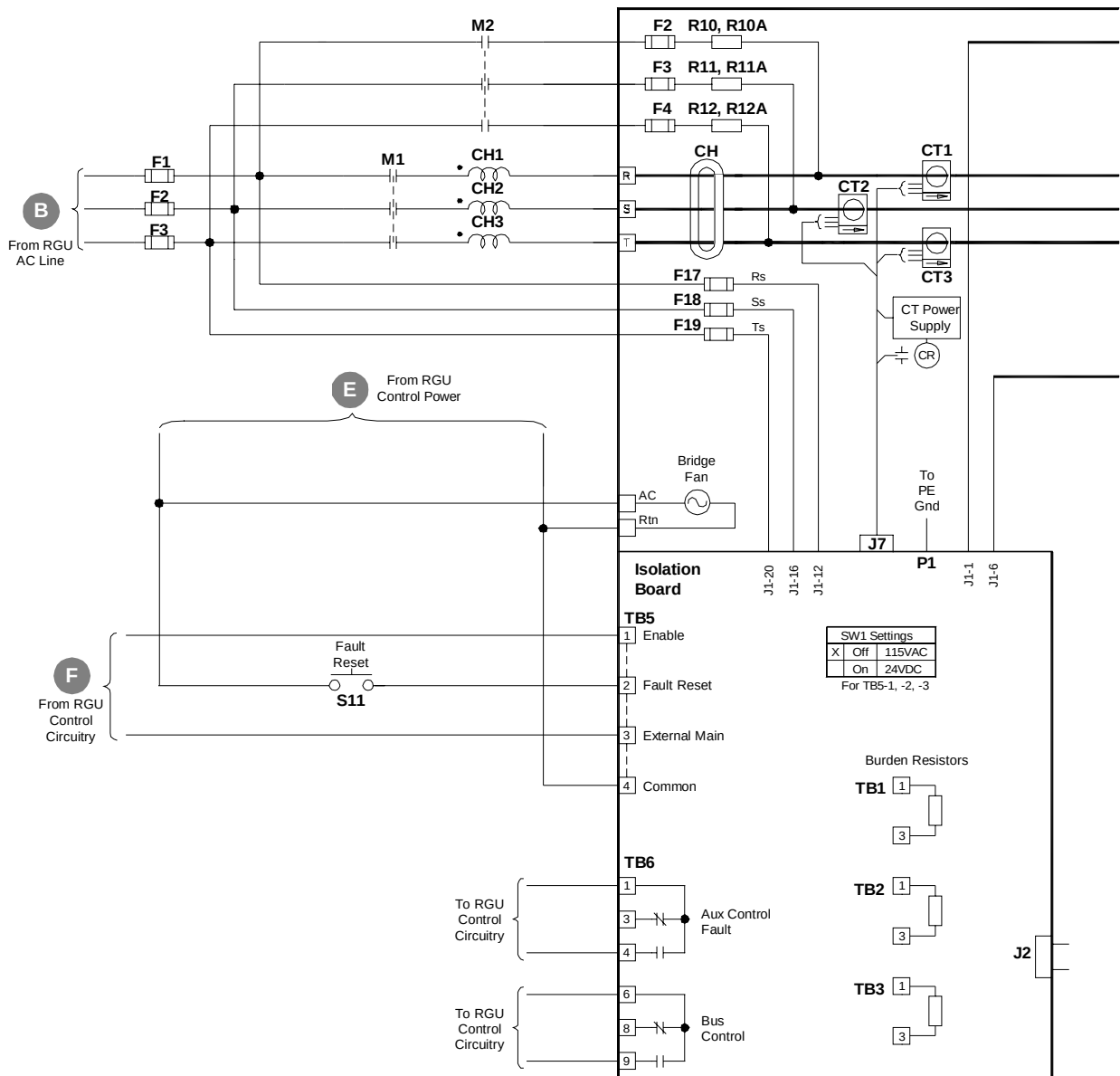
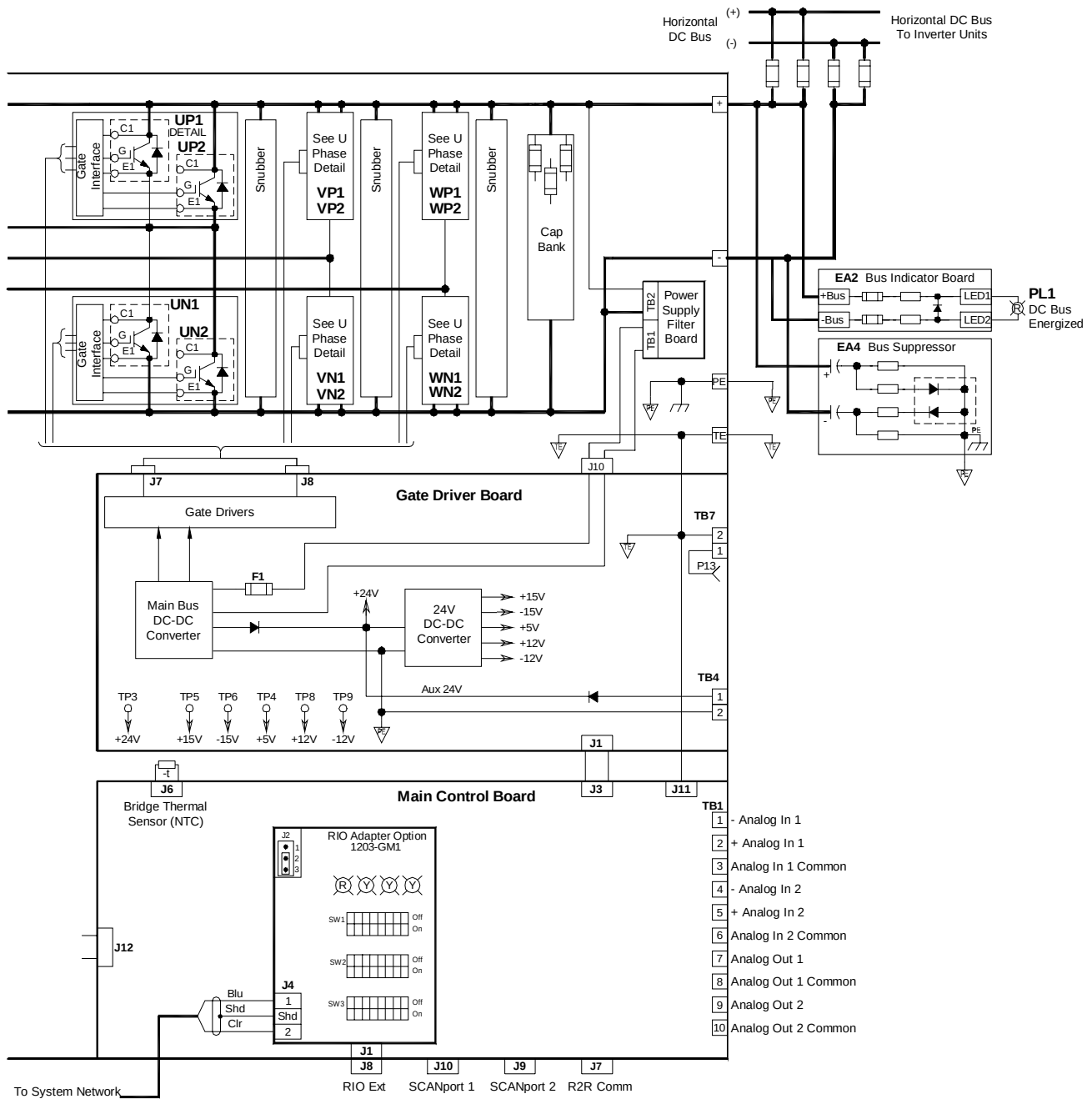


Figure 4.7
Schematics (cont.)





R4 and S4-Code Parallel Configurations

R4-Code Parallel Configuration

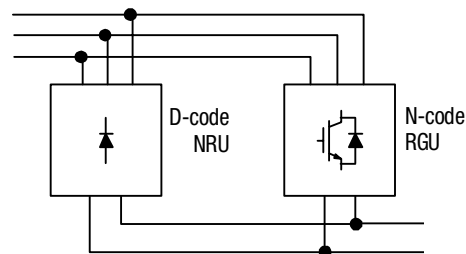
The R4-code parallel configuration is a common DC bus front-end unit consisting of an D-code NRU in parallel with an N-code RGU.

Figure 5.1
R4-Code Parallel Configuration—Information

R4-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	1600	821
460	1600	994
575	1591	1235

R4-code Parallel Configuration



S4-Code Parallel Configuration

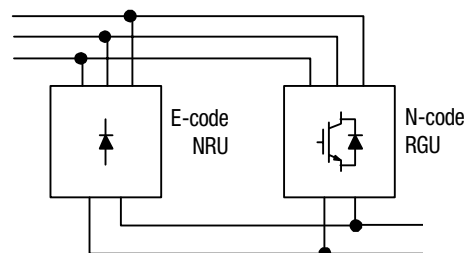
The S4-code parallel configuration is a common DC bus front-end unit consisting of an E-code NRU in parallel with an N-code RGU.

Figure 5.2
S4-Code Parallel Configuration—Information

S4-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2100	1077
460	2100	1304
575	2091	1623

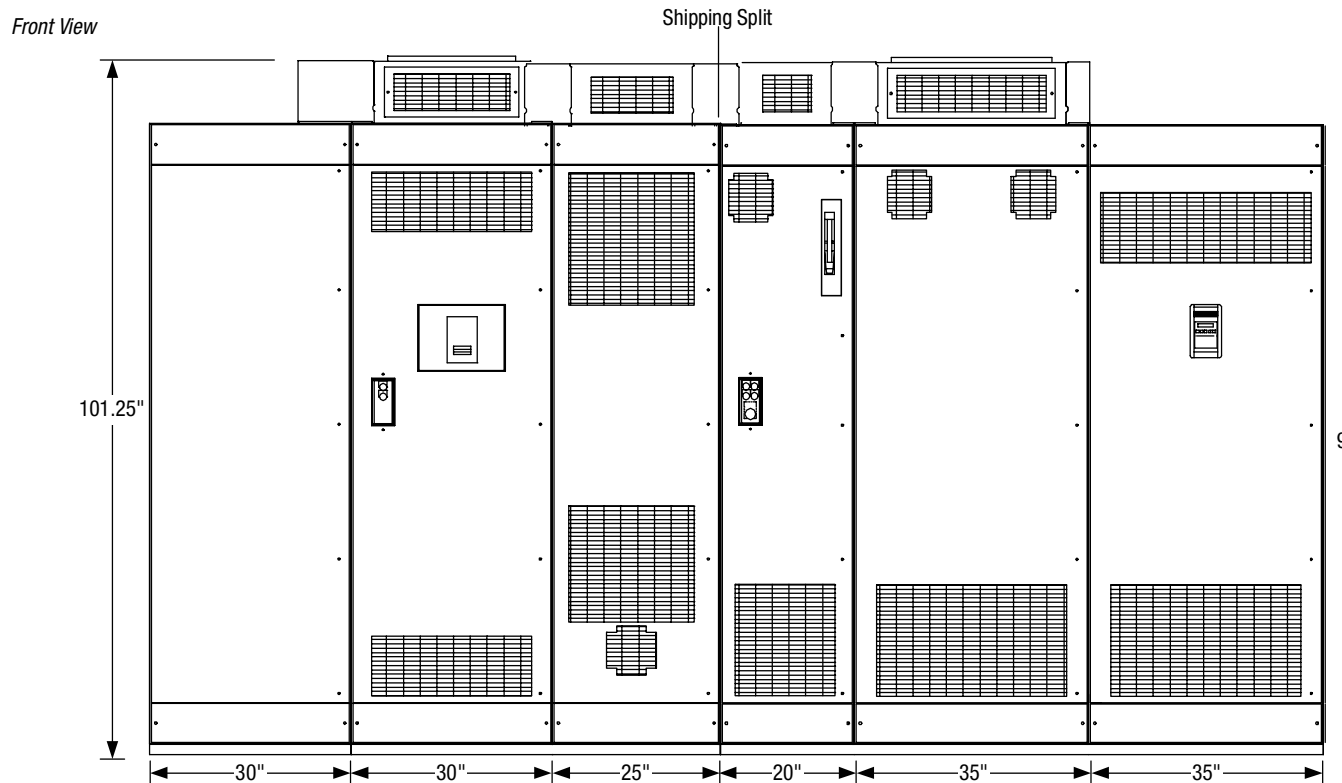
S4-code Parallel Configuration



Note: Information for the D-code NRU and E-code NRU can be found in publication 2364E-5.01. Information for the N-code RGU can be found in publication 2364F-5.01.

Component Layout

Figure 5.3
Enclosure Layout



Cutaway View

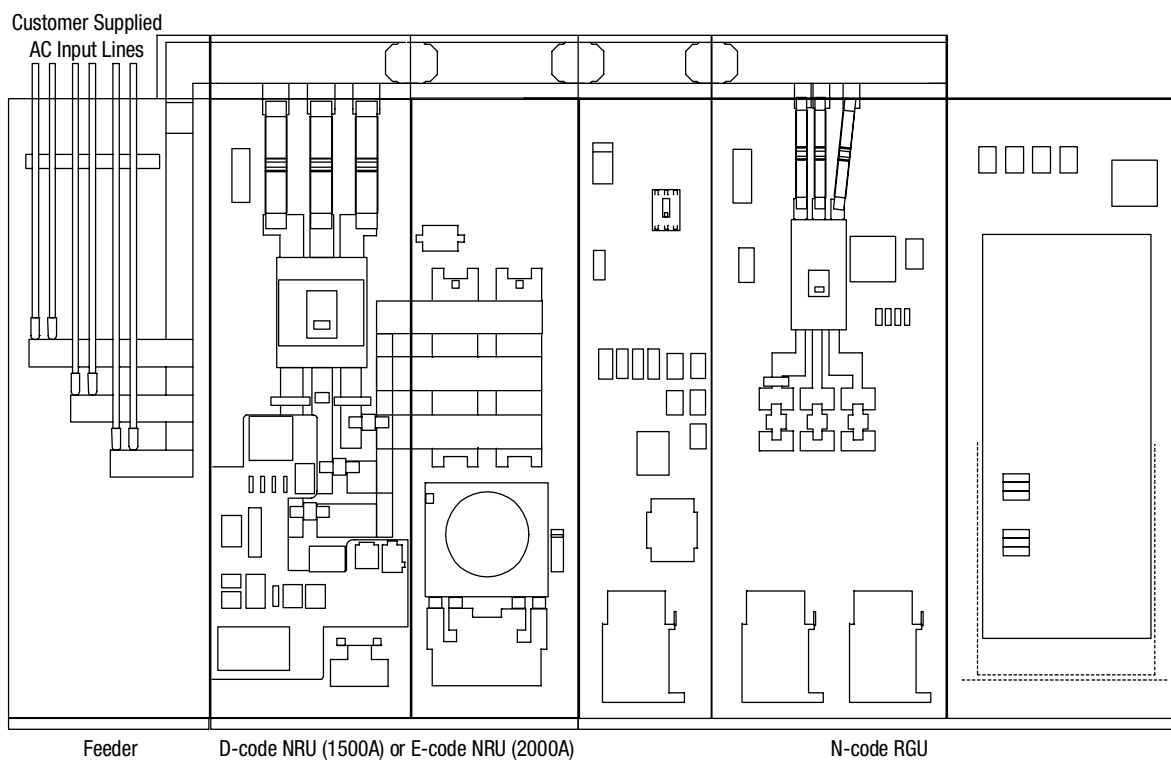
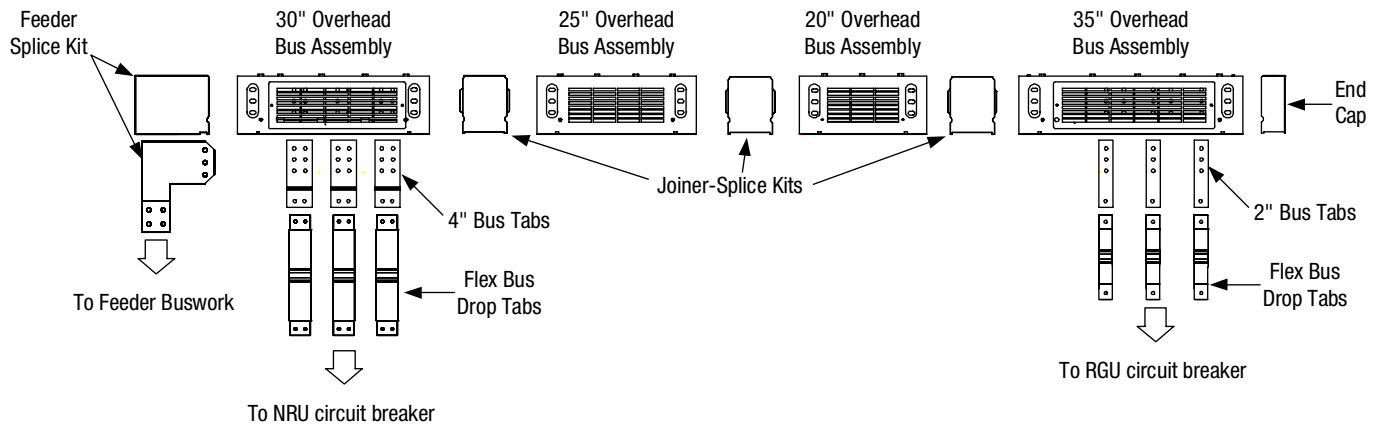


Figure 5.4
Overhead Bus Assembly

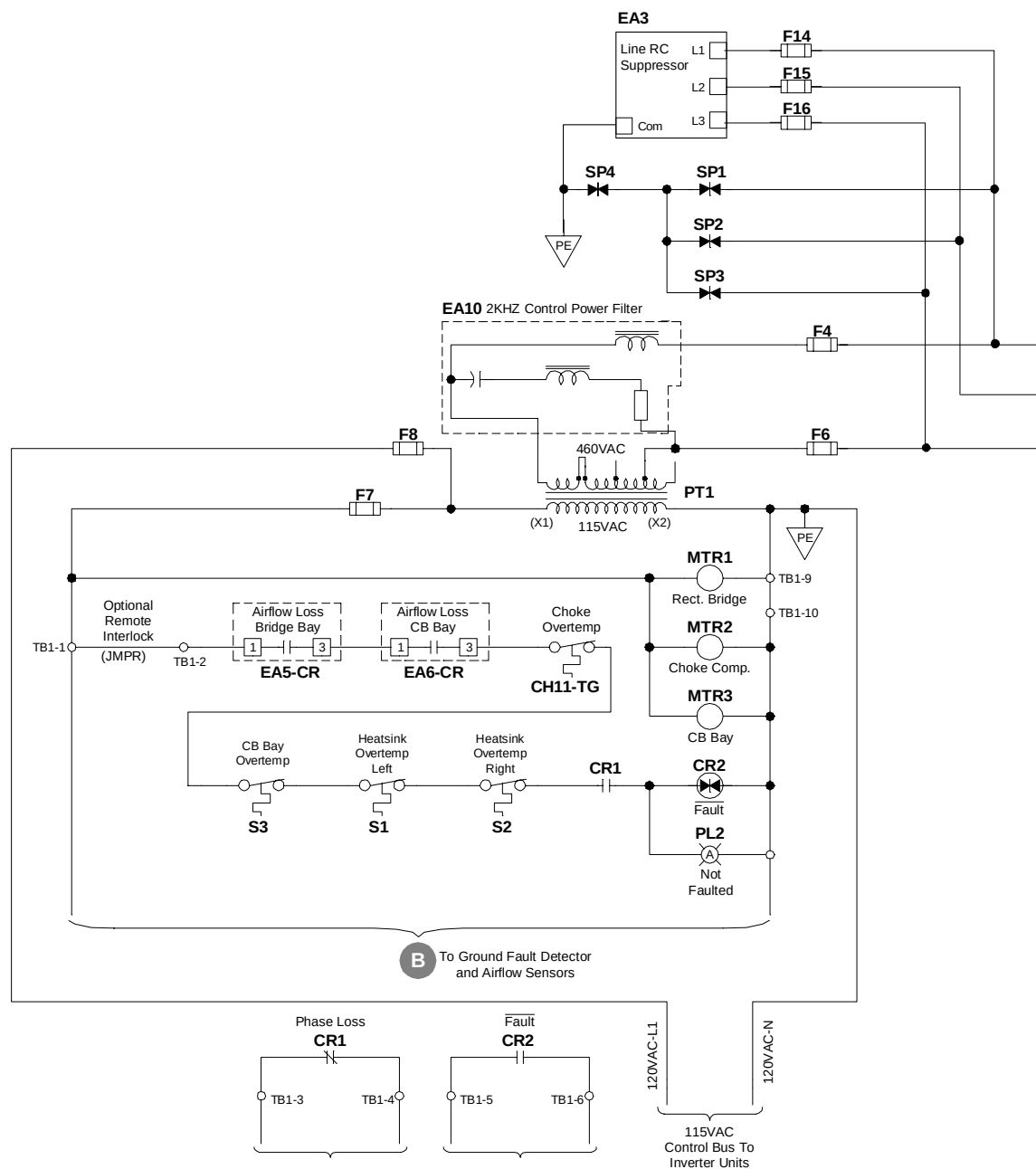


New and Revised NRU and RGU Components in the R4 and S4 Configurations

NRU	CB1	2000A, RD-frame with motor operator, aux contact (2NO/2NC)	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
TB10	Control terminal block, 30A, 600V		
RGU	CR3	Pilot Relay (2NO/2NC) with aux contact (1NO/1NC)	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	F4, F6	Primary fuse for 5kVA transformer	
		25A, KLDR (for 380V AC input)	
		20A, KLDR (for 460V AC input)	
		17.5A, KLDR (for 575V AC input)	
	F21, F22	DC bus fuses, 500A, 700V, 170M	
	21A, 22A		
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	
TR1	Timer relay (3NO/1NC)		
TB4	Control Terminal block, 30A, 600V		
Overhead bus assembly			

Figure 5.5 Schematics

NRU



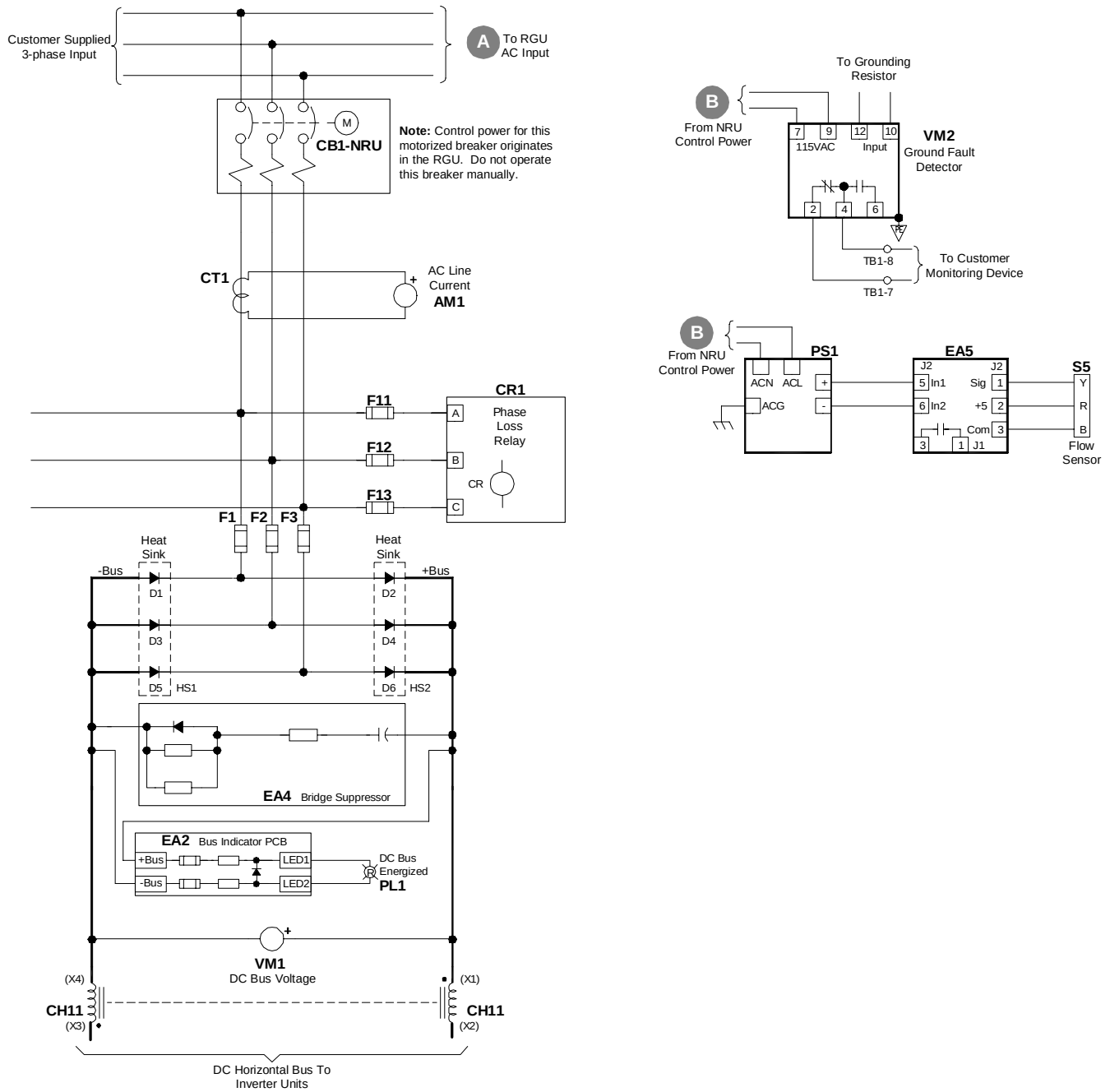
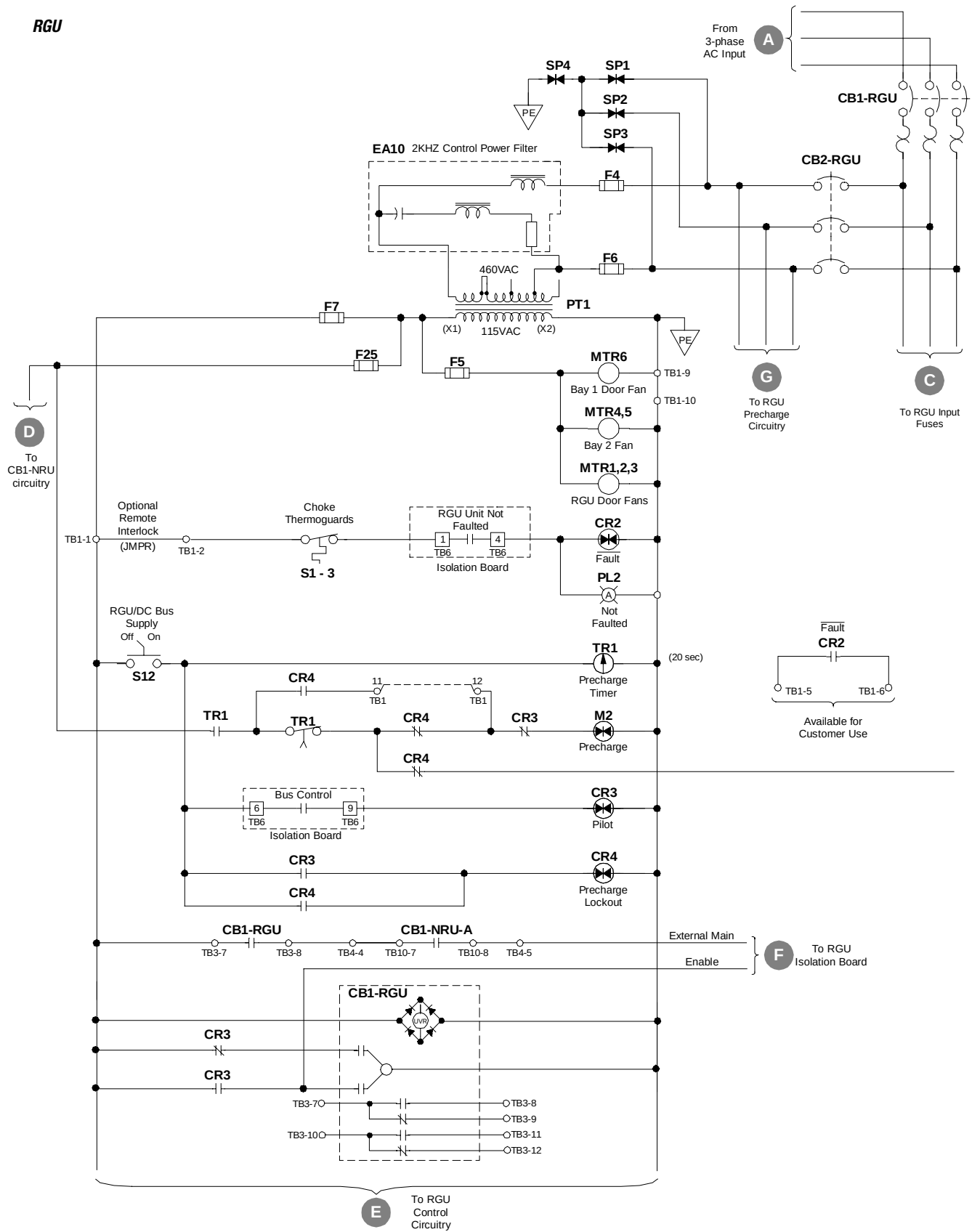


Figure 5.6
Schematics (cont.)

RGU



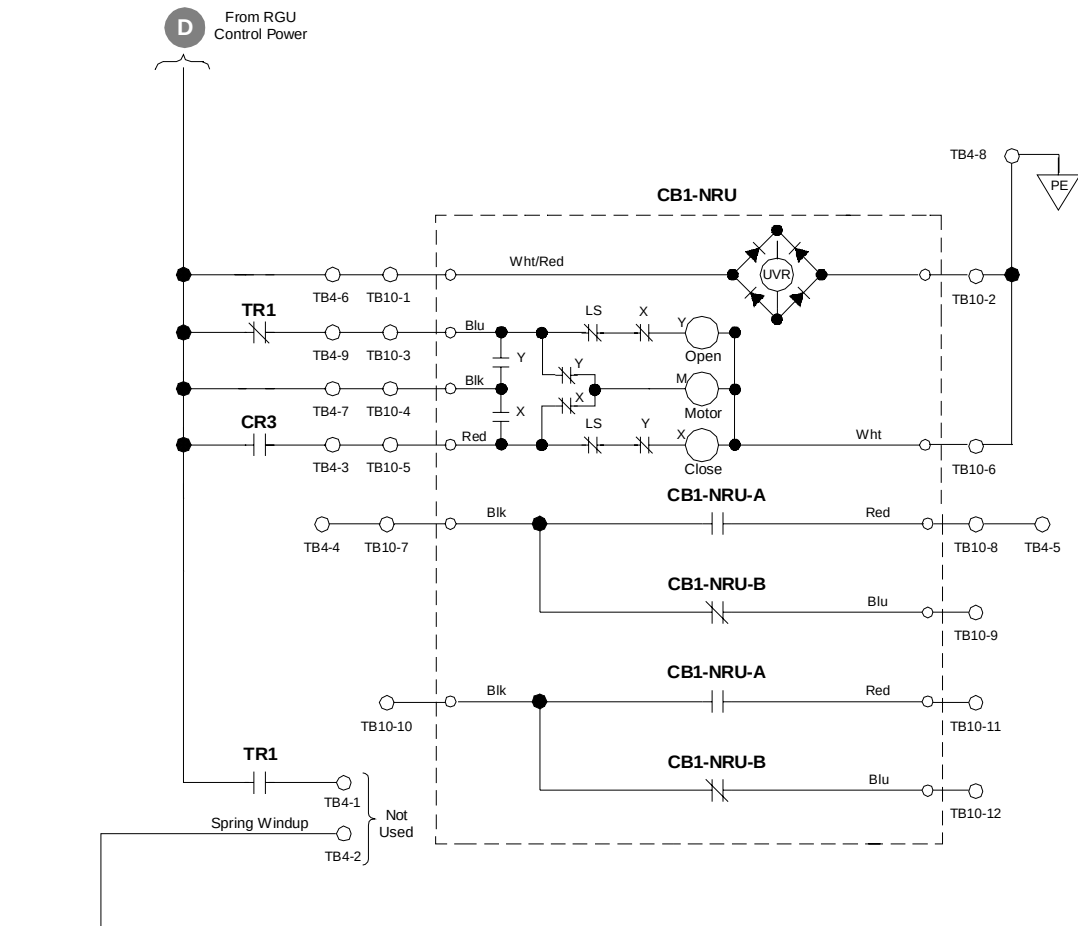
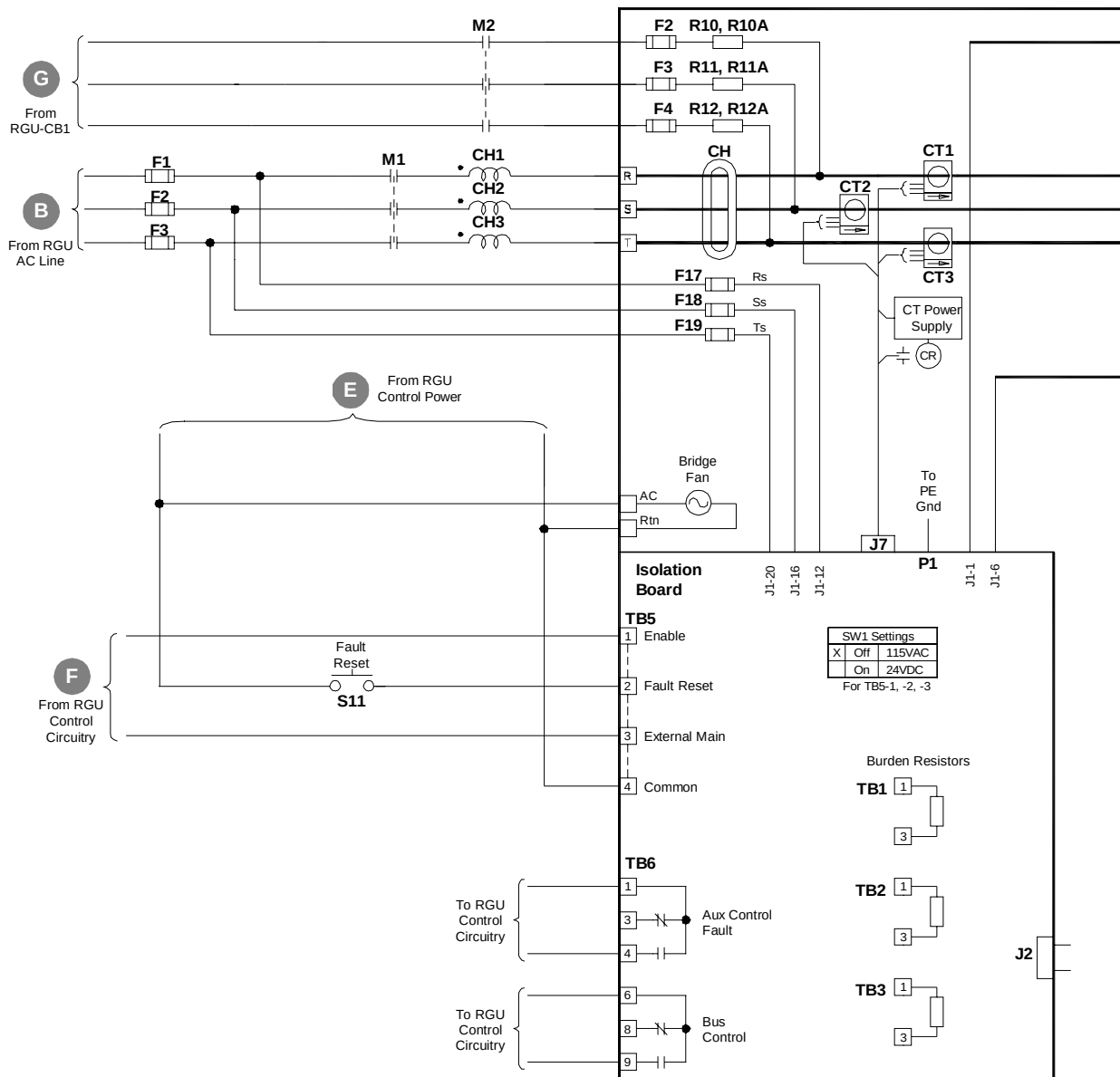
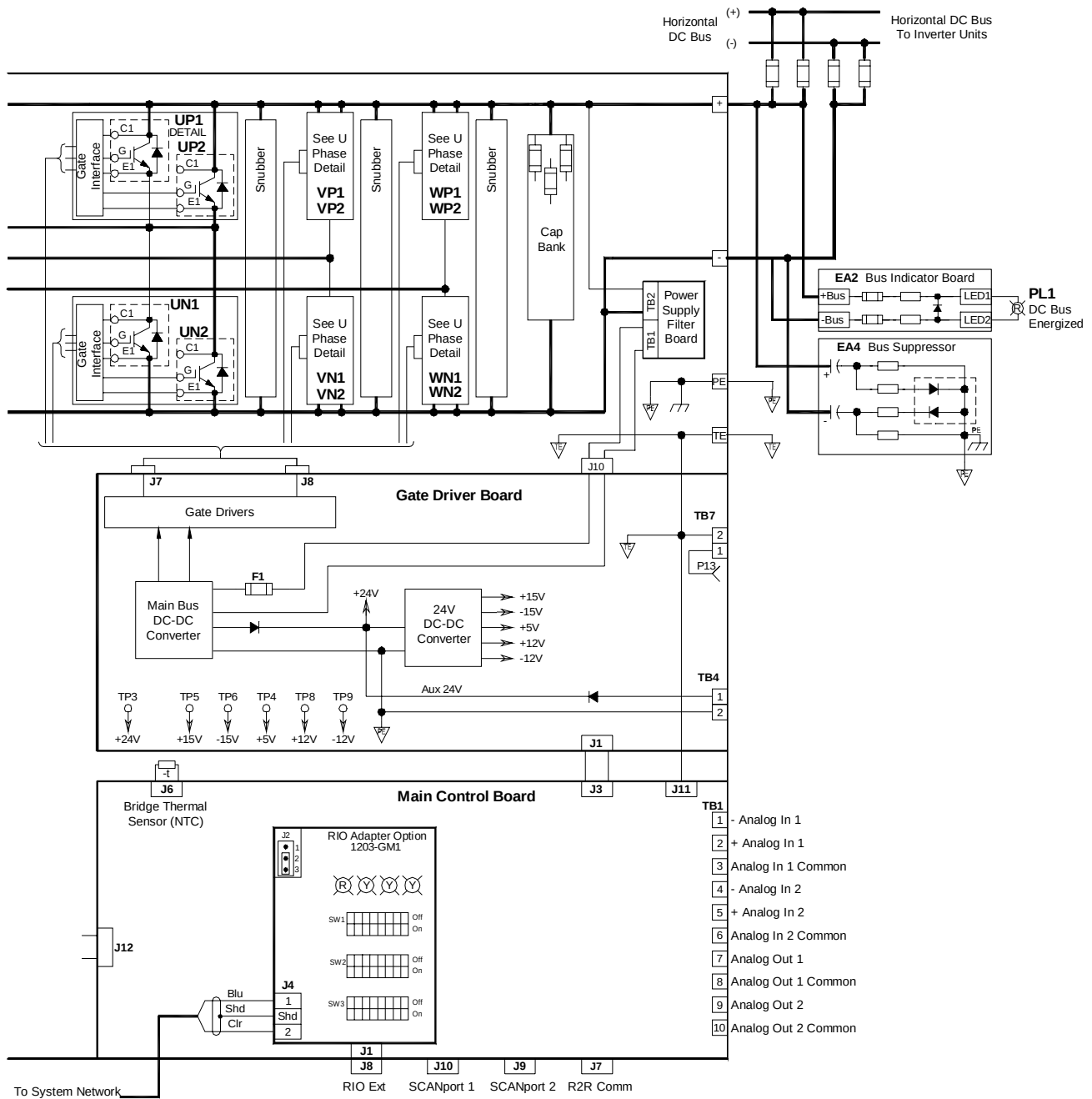


Figure 5.7
Schematics (cont.)





T1 and V1-Code Parallel Configurations

T1-Code Parallel Configuration

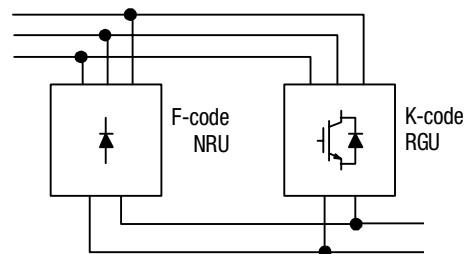
The T1-code parallel configuration is a common DC bus front-end unit consisting of an F-code NRU in parallel with a K-code RGU.

Figure 6.1
T1-Code Parallel Configuration—Information

T1-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2520	1293
460	2520	1565
575	2520	1956

T1-code Parallel Configuration



V1-Code Parallel Configuration

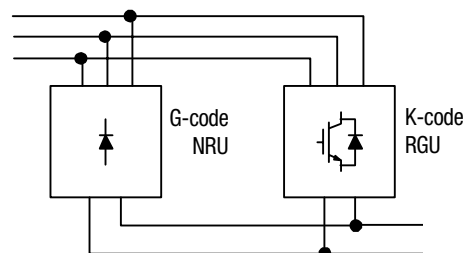
The V1-code parallel configuration is a common DC bus front-end unit consisting of an G-code NRU in parallel with a K-code RGU.

Figure 6.2
V1-Code Parallel Configuration—Information

V1-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	3000	1539
460	3000	1863
575	3000	2329

V1-code Parallel Configuration



Note: Information for the F-code NRU and G-code NRU can be found in publication 2364E-5.01. Information for the K-code RGU can be found in publication 2364F-5.01.

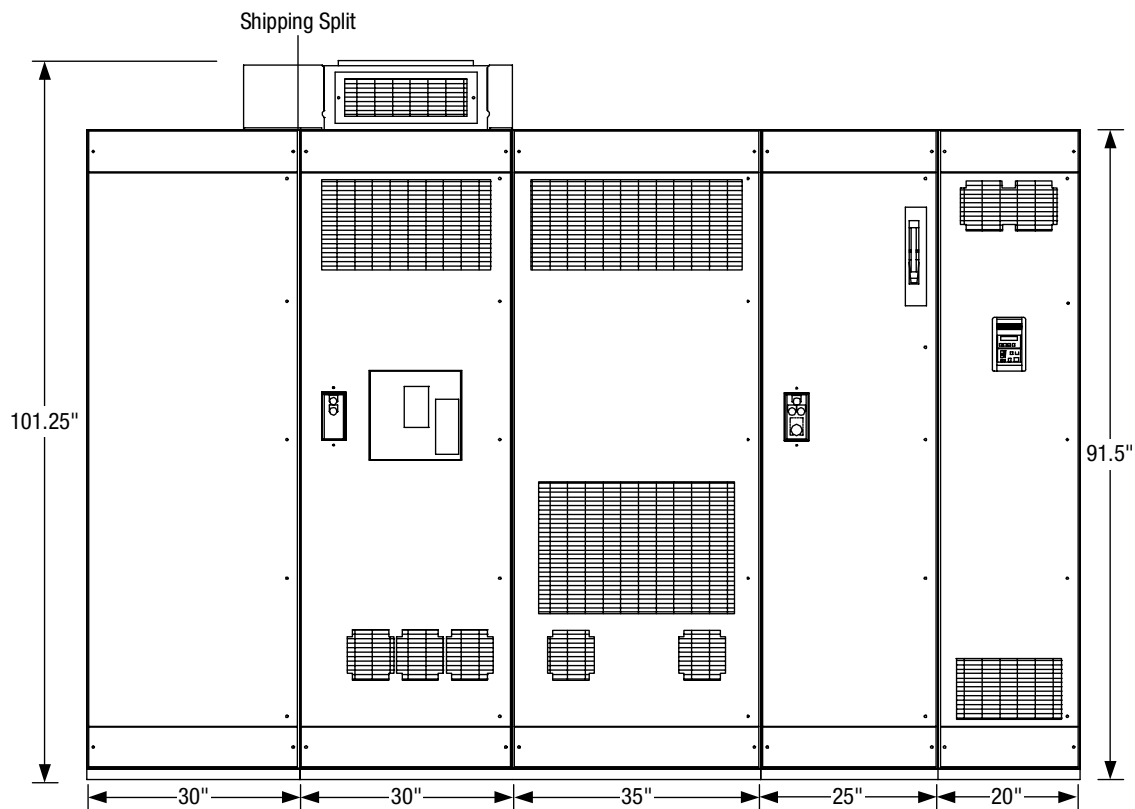
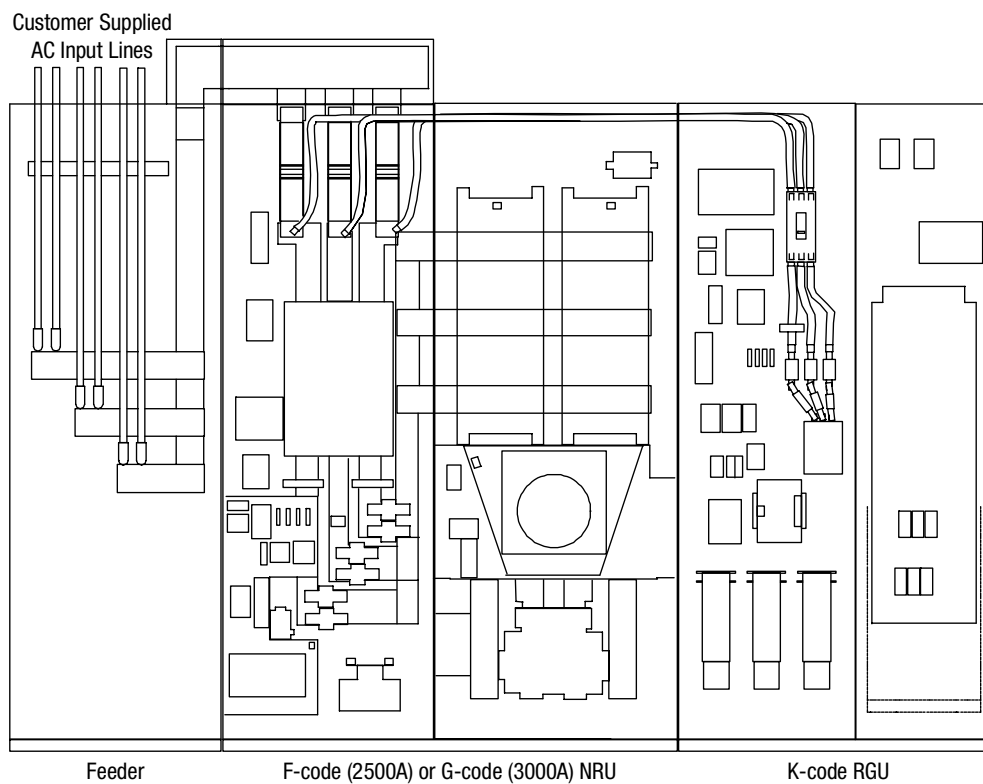
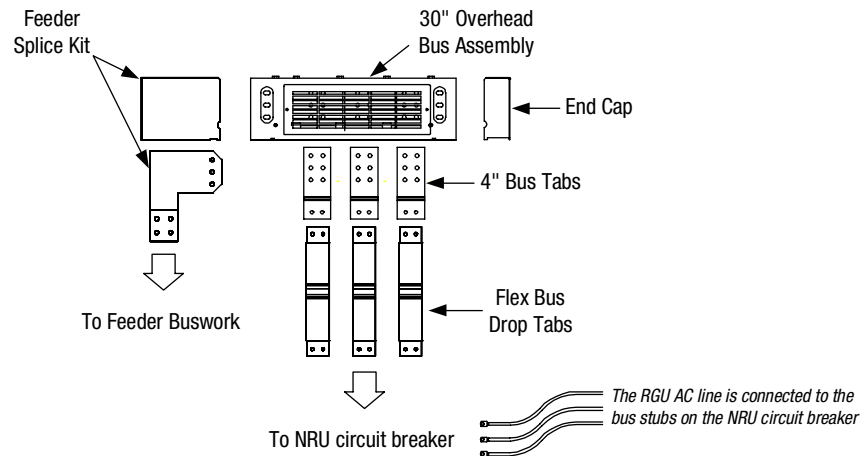
Component Layout**Figure 6.3
Enclosure Layout***Front View**Cutaway View*

Figure 6.4
Overhead Bus Assembly



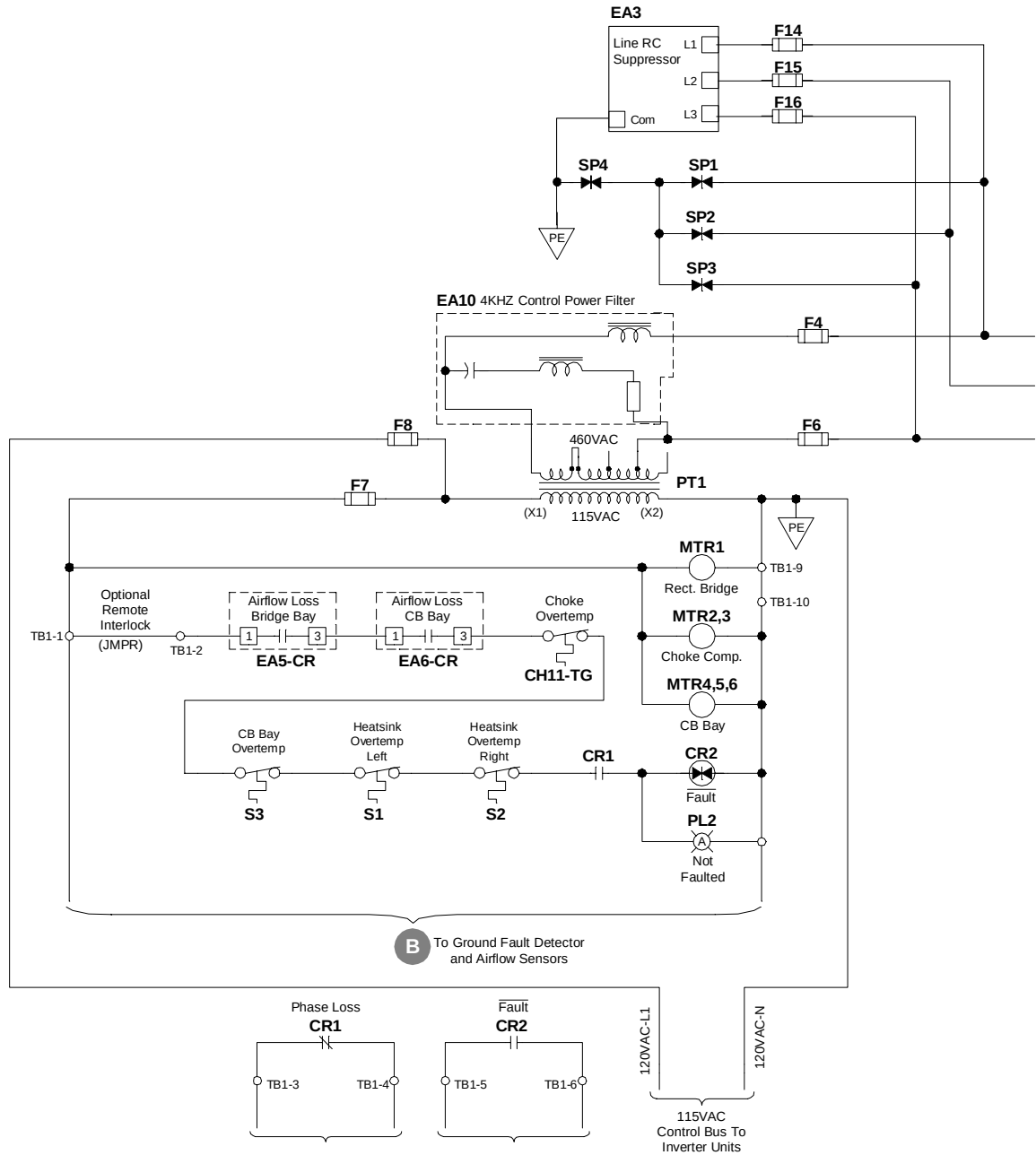
New and Revised NRU and RGU Components in the T1 and V1 Configurations

NRU	CB1	(T1 config) 2500A, SPB-frame with motor operator (V1 config) 3000A, SPB-frame with motor operator	
	EA10	Control power filter, 4kHz	
	F4, F6	Primary fuse for 5kVA control transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	Primary fuse for 10kVA control transformer (Opt 6P) 35A, KLDR (for 380V AC input) 30A, KLDR (for 460V AC input) 25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
	TB10	Control terminal block, 30A, 600V	
RGU	CR4	Precharge Lockout Relay (2NO/2NC)	
	F4, F6	Primary fuse for 2kVA transformer 10A, KLDR (for 380V AC input) 9A, KLDR (for 460V AC input) 8A, KLDR (for 575V AC input)	
	F21, F22	DC bus fuses, 250A, 700V, 170M	
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 2kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
	Overhead bus assembly		

Schematics

Figure 6.5
Schematics

NRU



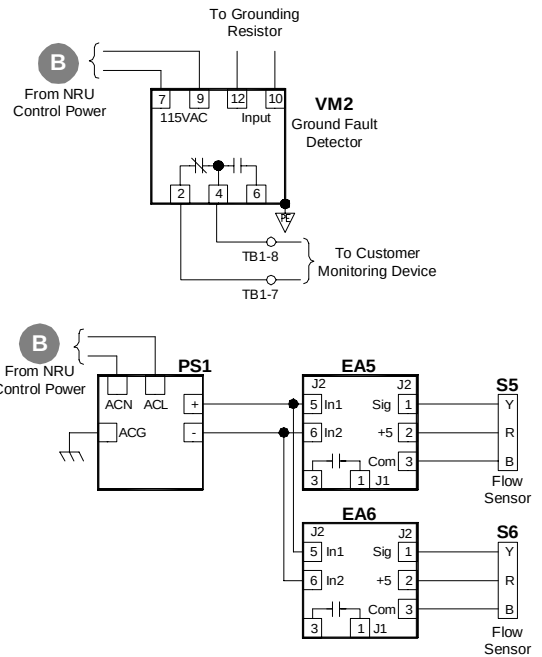
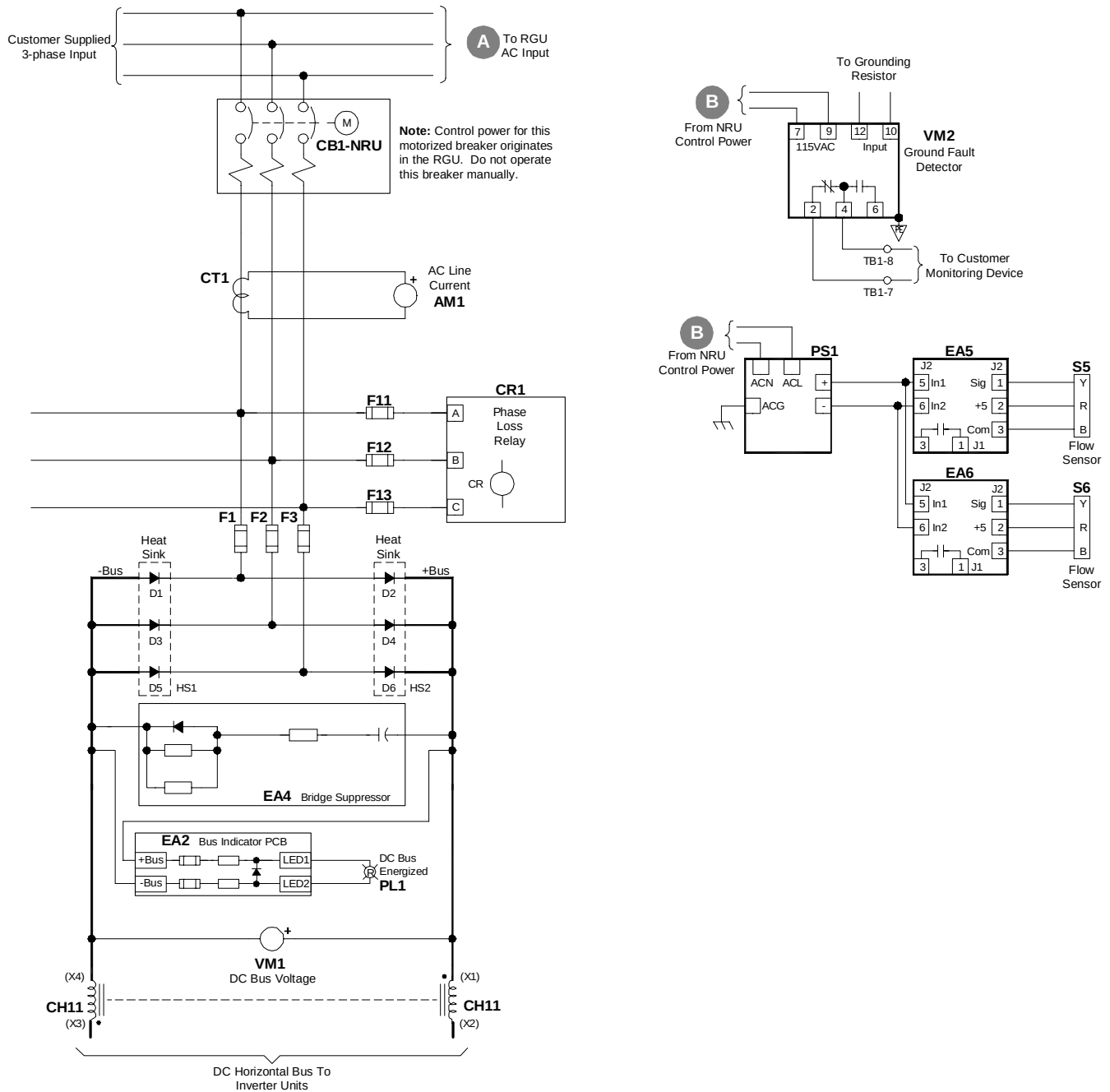
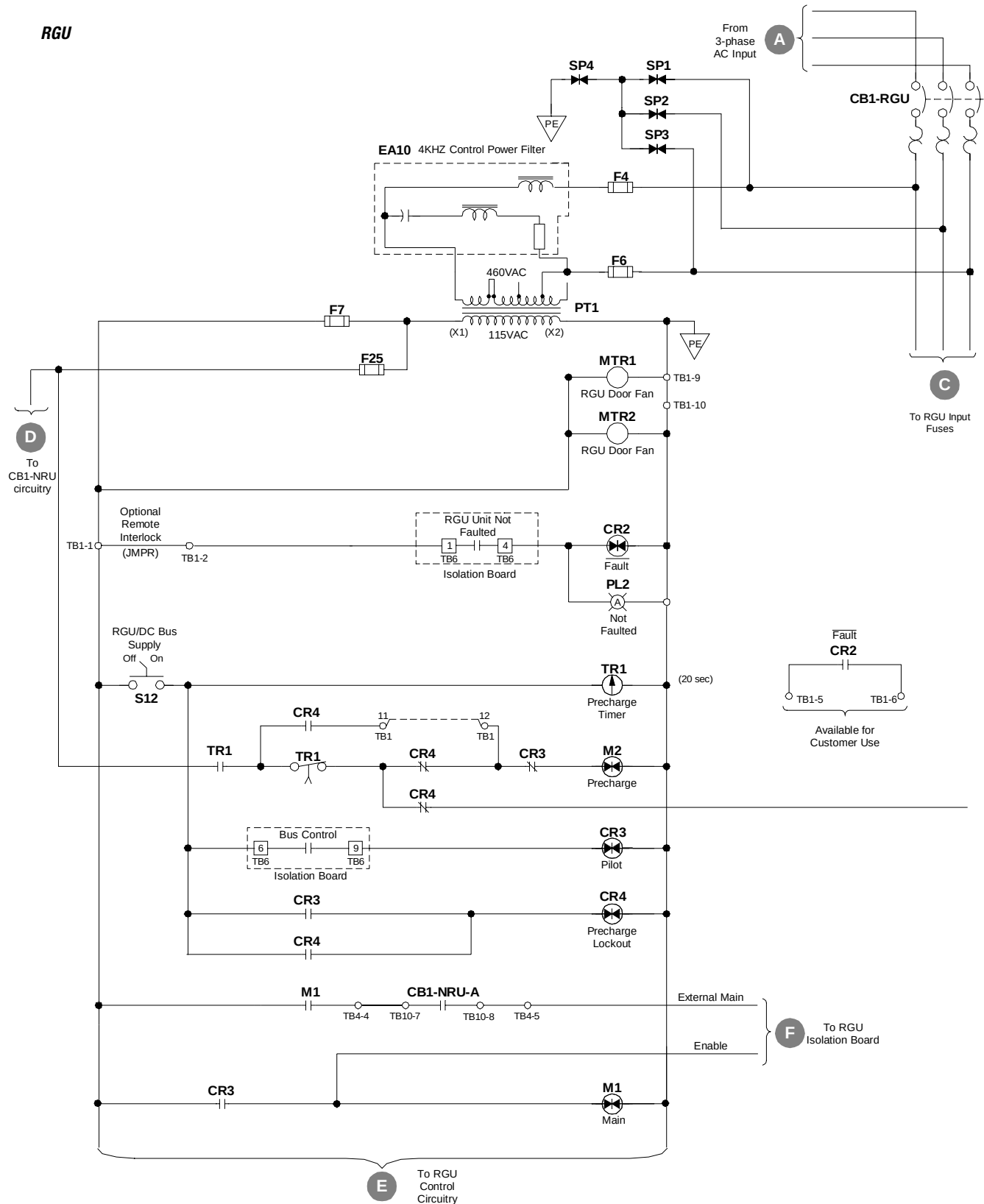


Figure 6.6
Schematics (cont.)



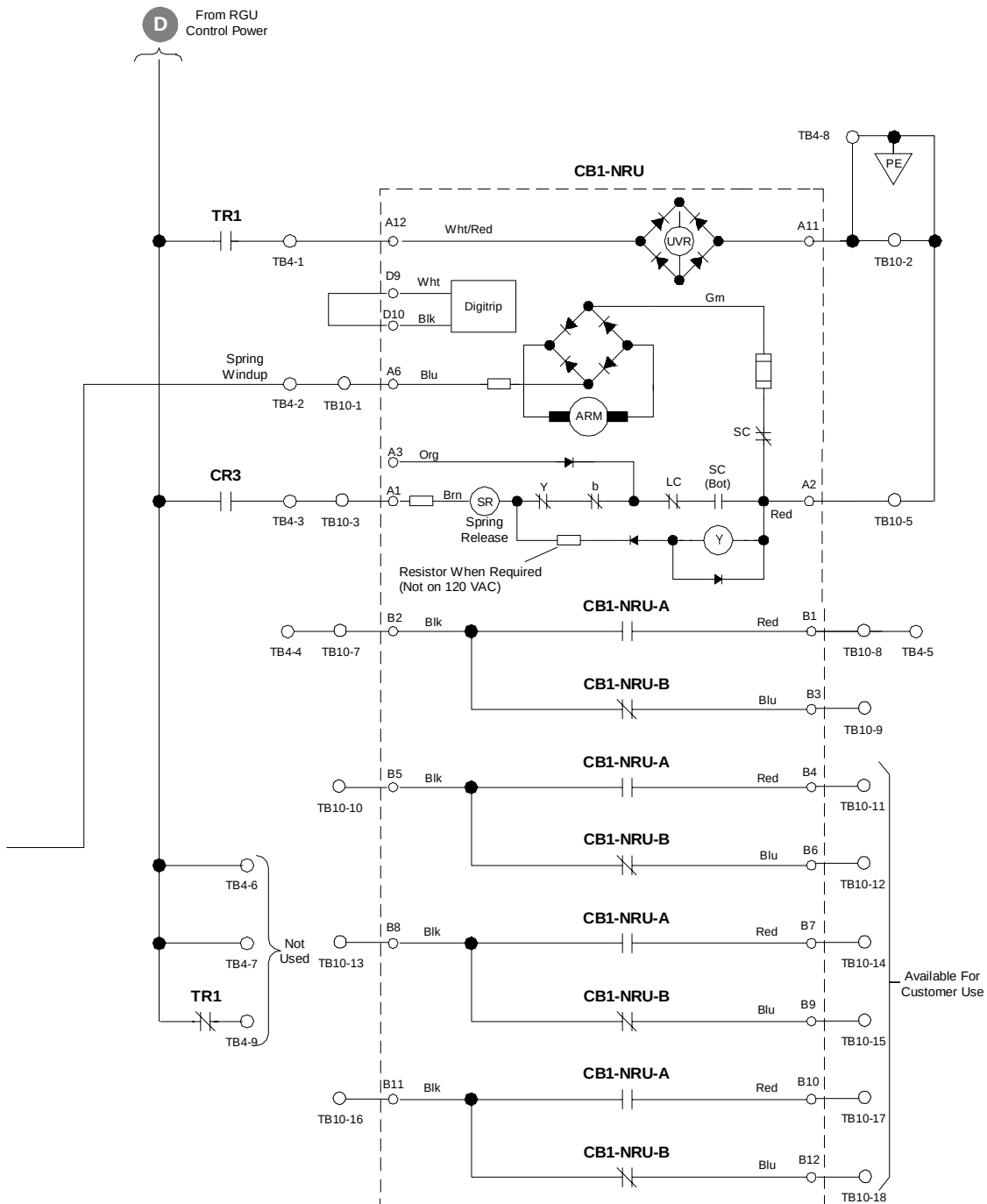
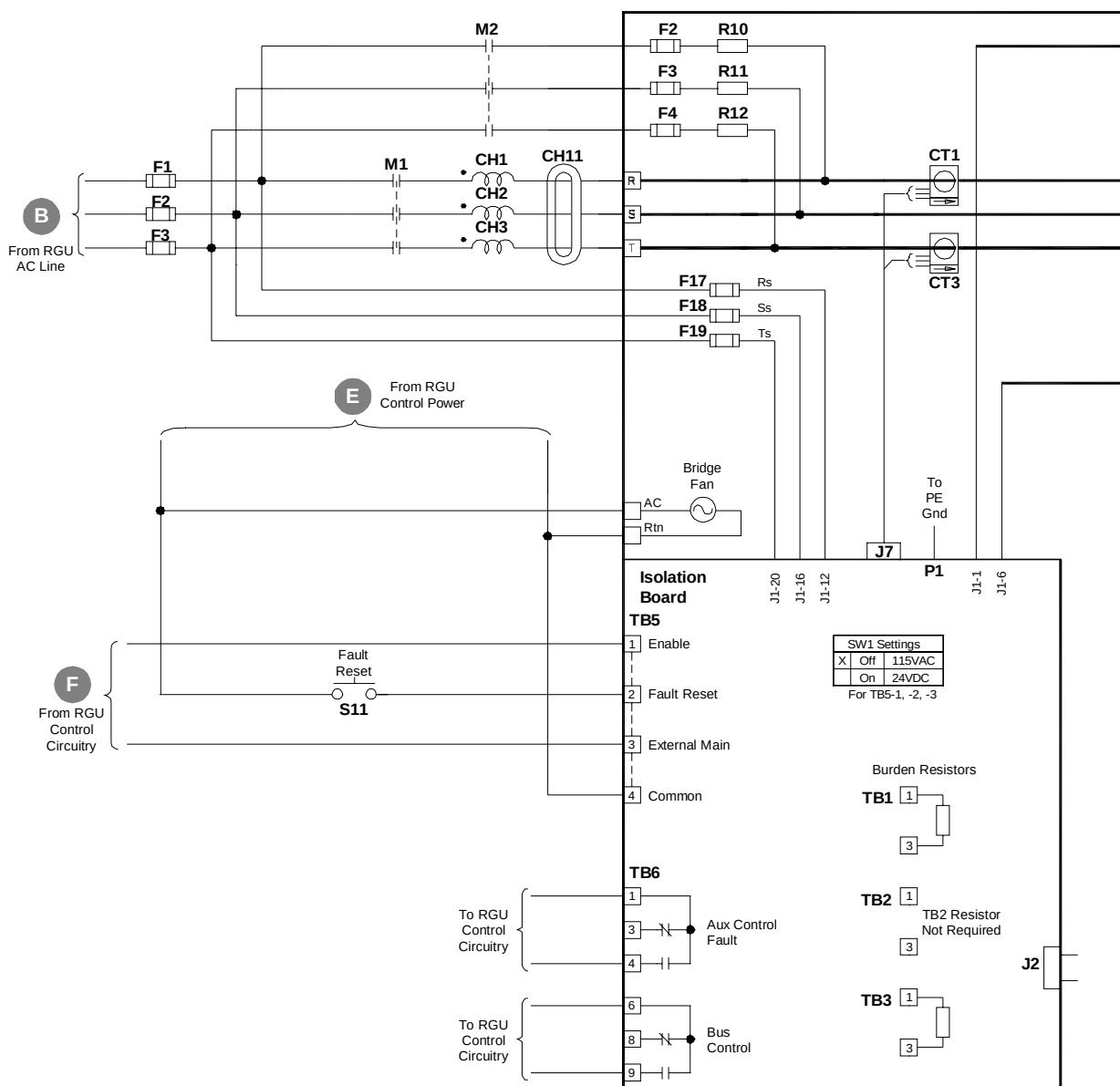
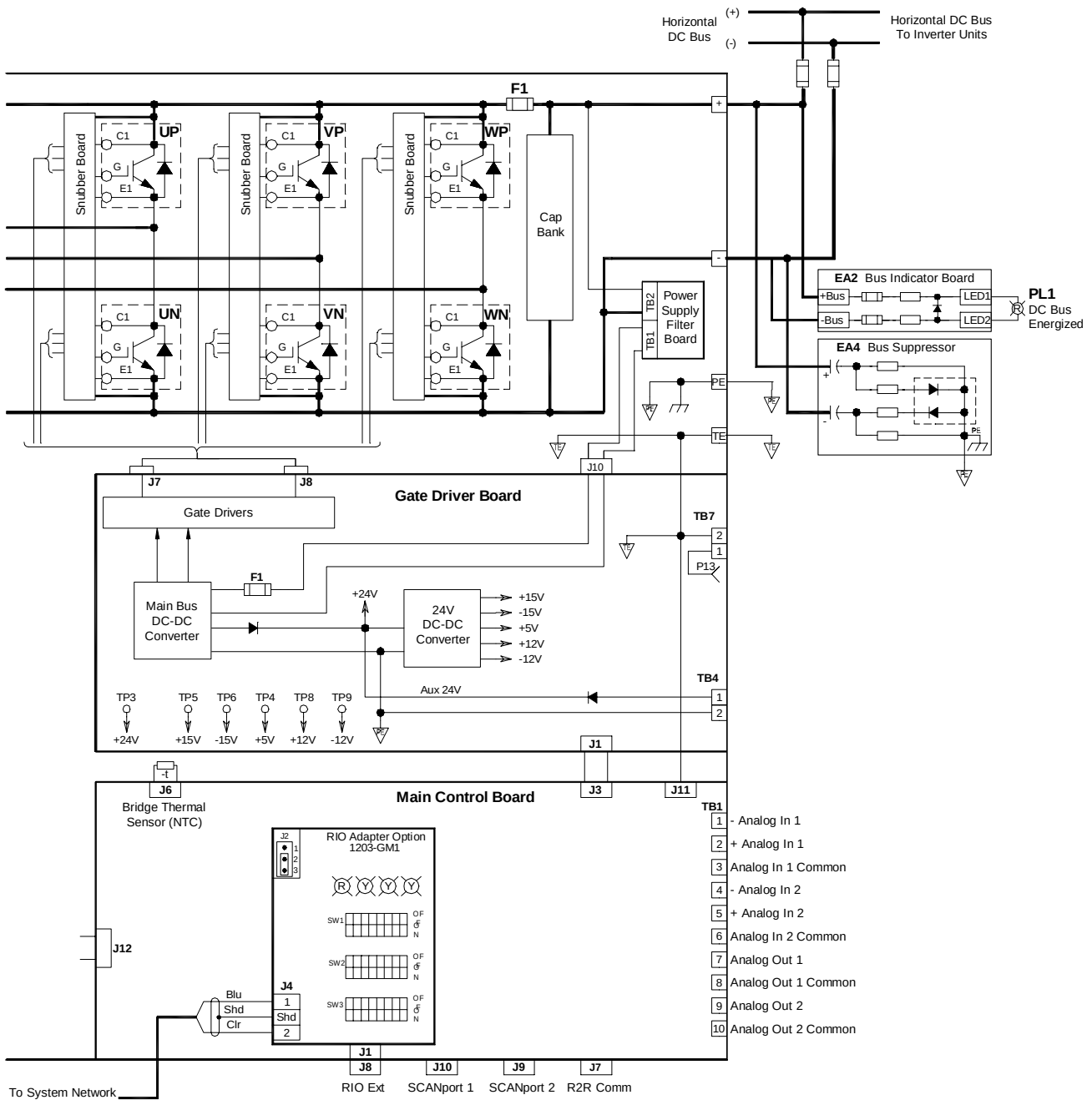


Figure 6.7
Schematics (cont.)





T2 and V2-Code Parallel Configurations

T2-Code Parallel Configuration

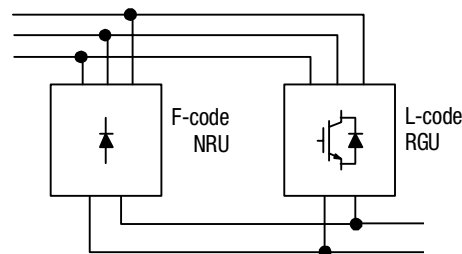
The T2-code parallel configuration is a common DC bus front-end unit consisting of an F-code NRU in parallel with a L-code RGU.

Figure 7.1
T2-Code Parallel Configuration—Information

T2-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2536	1301
460	2536	1575
575	2536	1966

T2-code Parallel Configuration



V2-Code Parallel Configuration

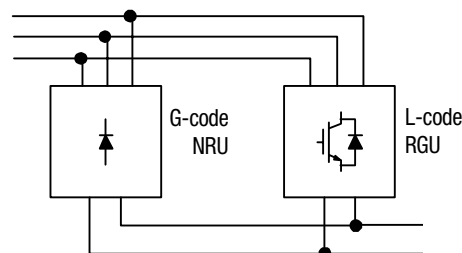
The V2-code parallel configuration is a common DC bus front-end unit consisting of an G-code NRU in parallel with a L-code RGU.

Figure 7.2
V2-Code Parallel Configuration—Information

V2-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	3000	1539
460	3000	1863
575	3000	2329

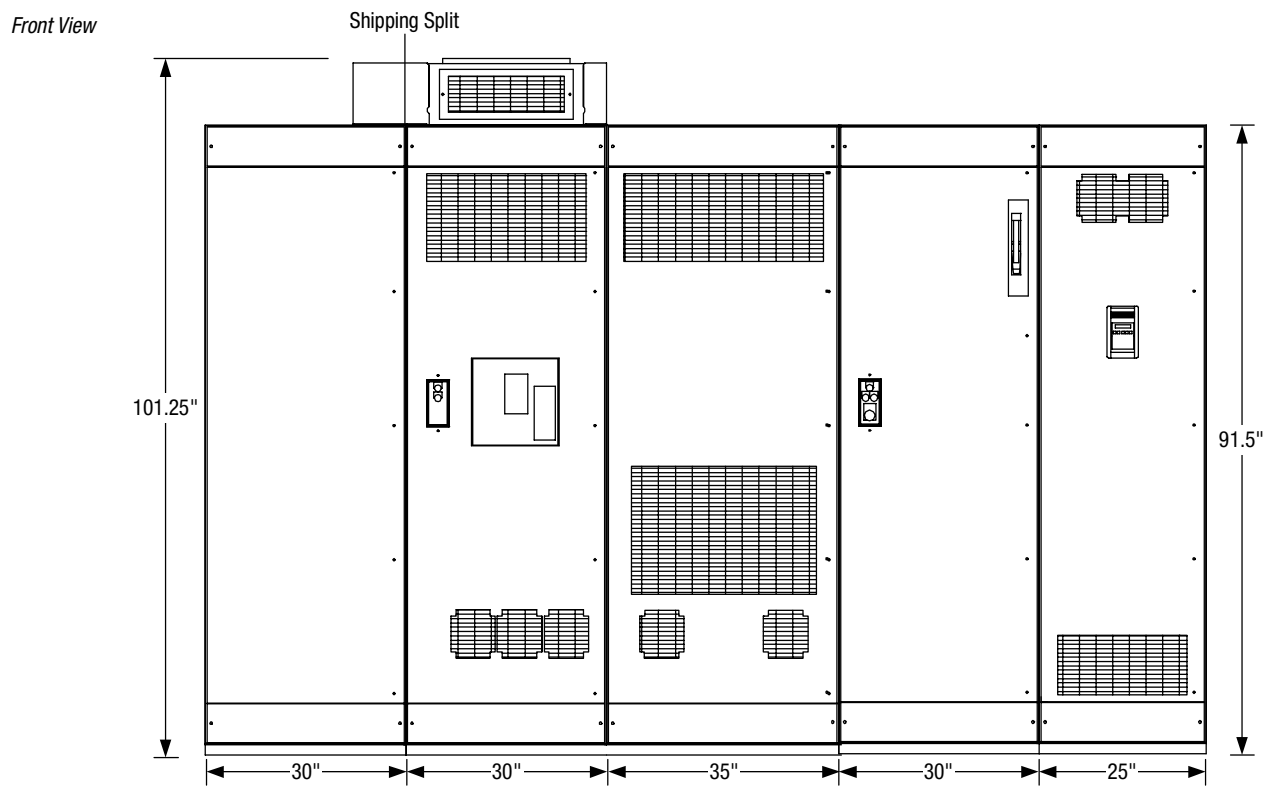
V2-code Parallel Configuration



Note: Information for the F-code NRU and G-code NRU can be found in publication 2364E-5.01. Information for the L-code RGU can be found in publication 2364F-5.01.

Component Layout

Figure 7.3
Enclosure Layout



Cutaway View

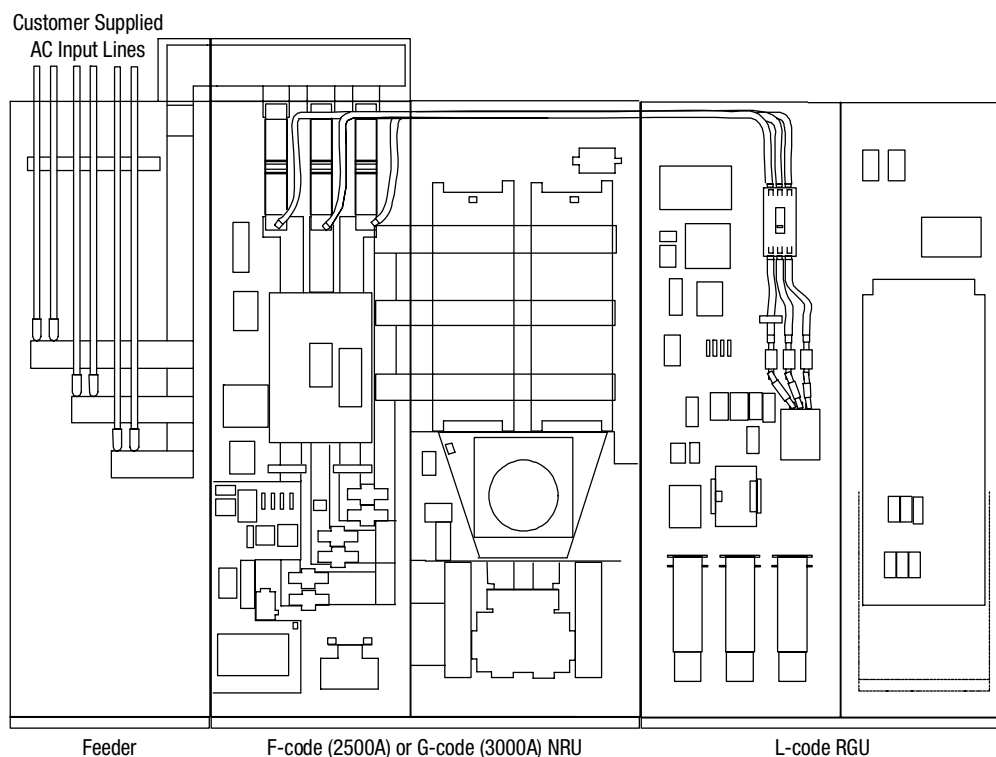
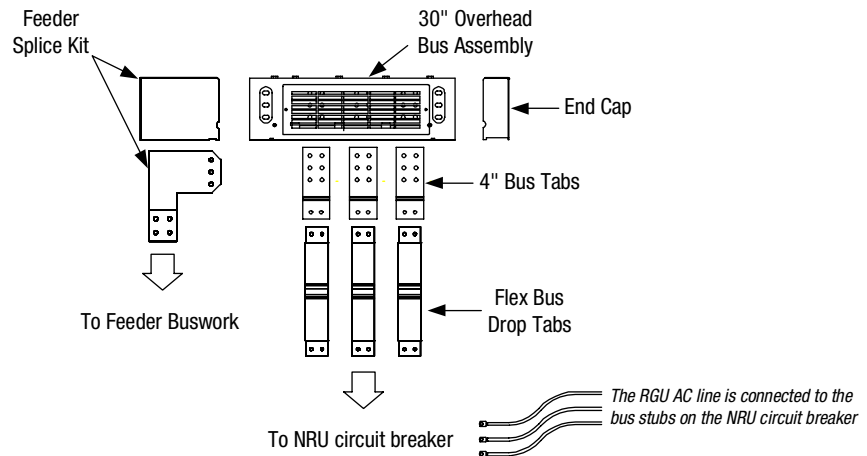


Figure 7.4
Overhead Bus Assembly

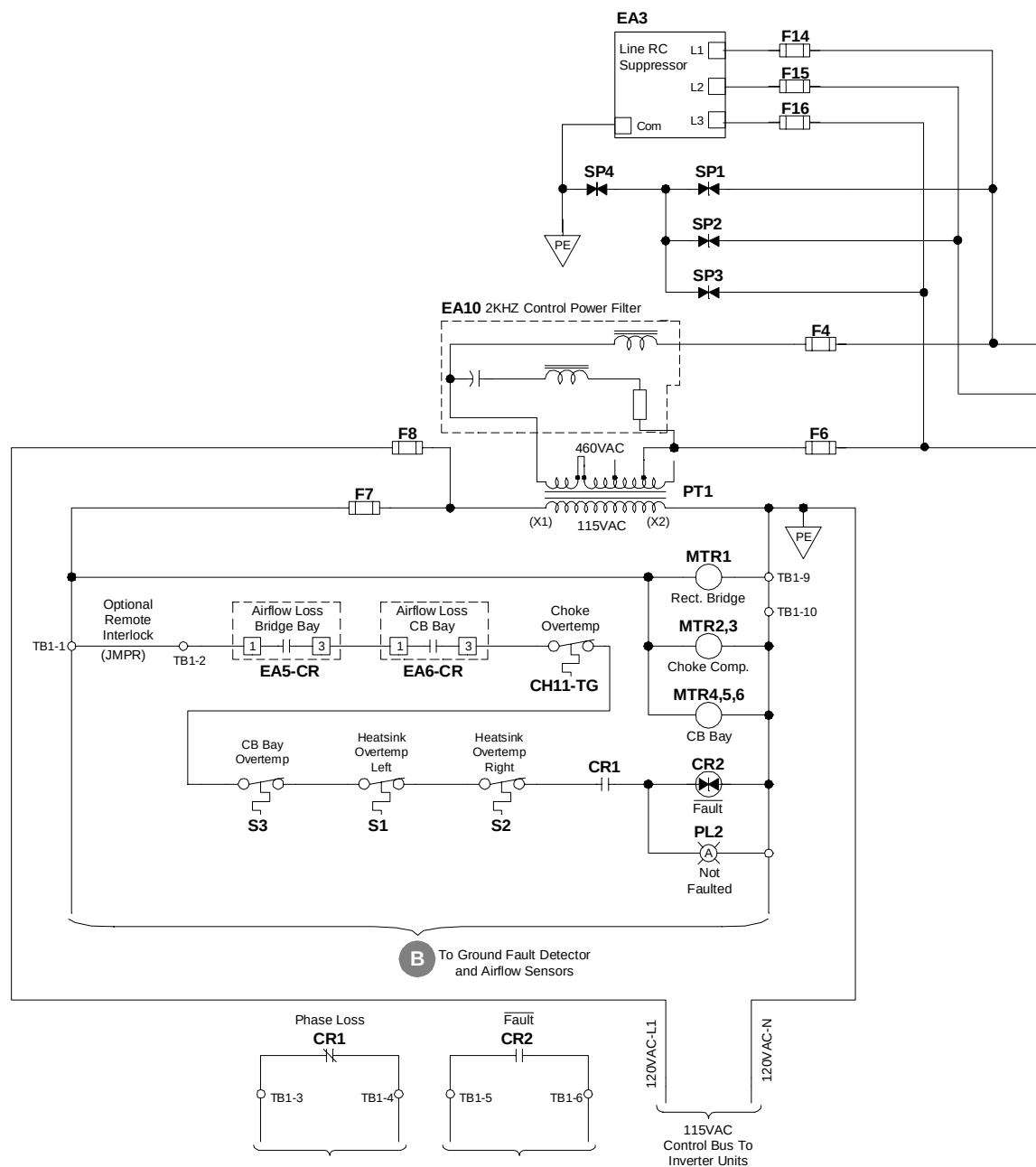


New and Revised NRU and RGU Components in the T2 and V2 Configurations

NRU	CB1	(T1 config) 2500A, SPB-frame with motor operator (V1 config) 3000A, SPB-frame with motor operator	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	Primary fuse for 10kVA control transformer (Opt 6P) 35A, KLDR (for 380V AC input) 30A, KLDR (for 460V AC input) 25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
	TB10	Control terminal block, 30A, 600V	
RGU	CR4	Precharge Lockout Relay (2NO/2NC)	
	F4, F6	Primary fuse for 5kVA transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	
	F21, F22	DC bus fuses, 500A, 700V, 170M	
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
	Overhead bus assembly		

Schematics

Figure 7.5 Schematics

NRU

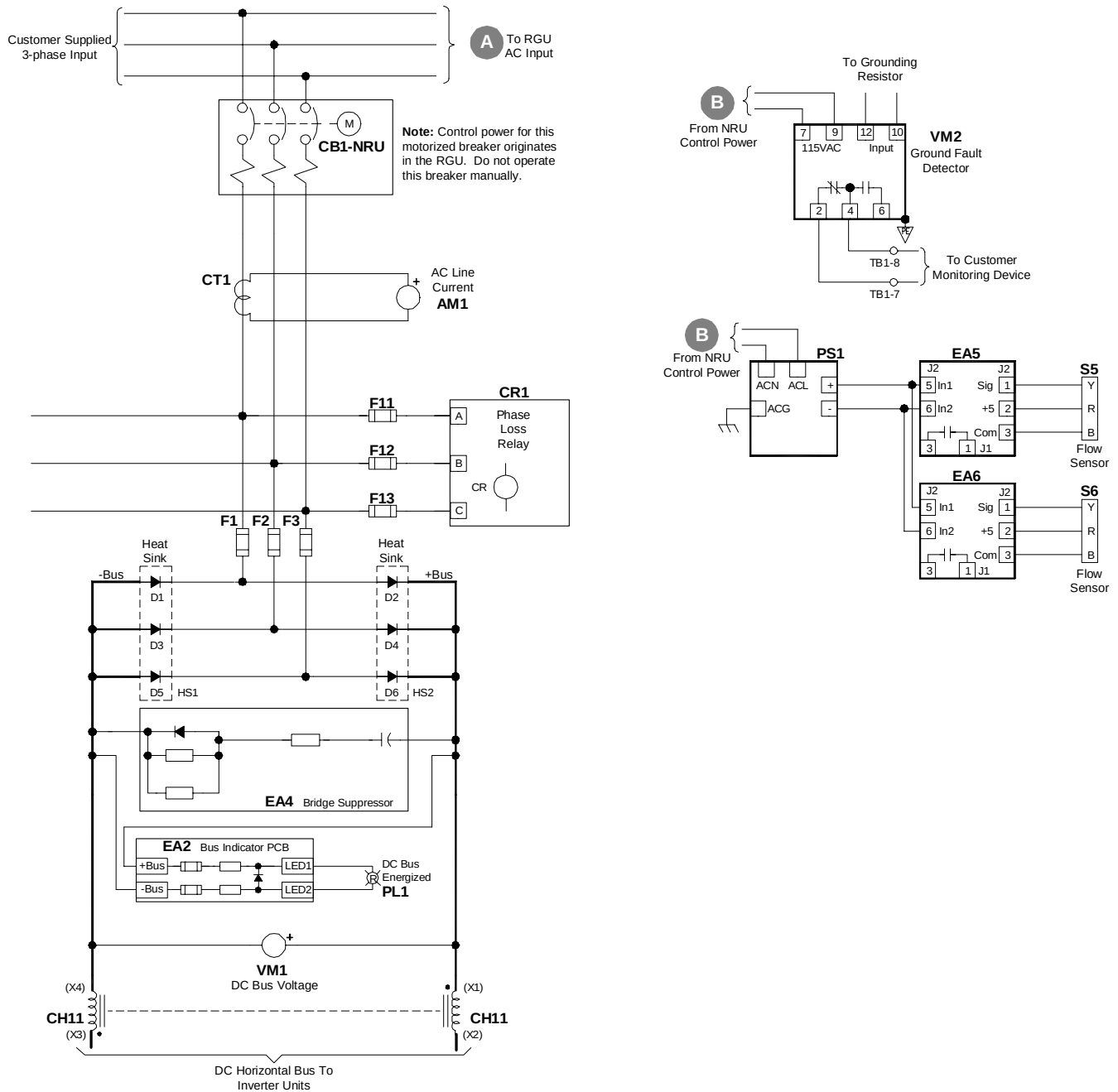
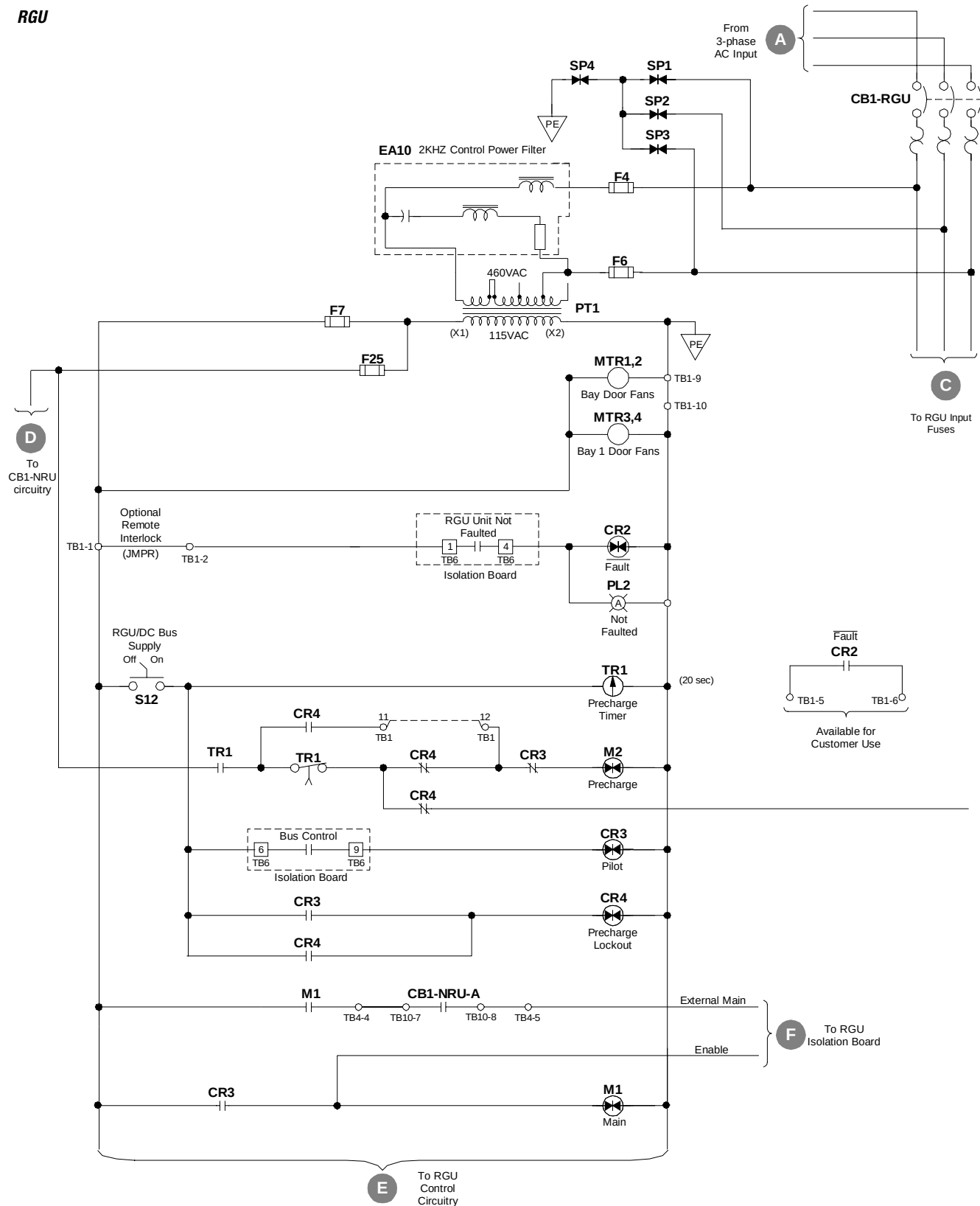


Figure 7.6
Schematics (cont.)

RGU

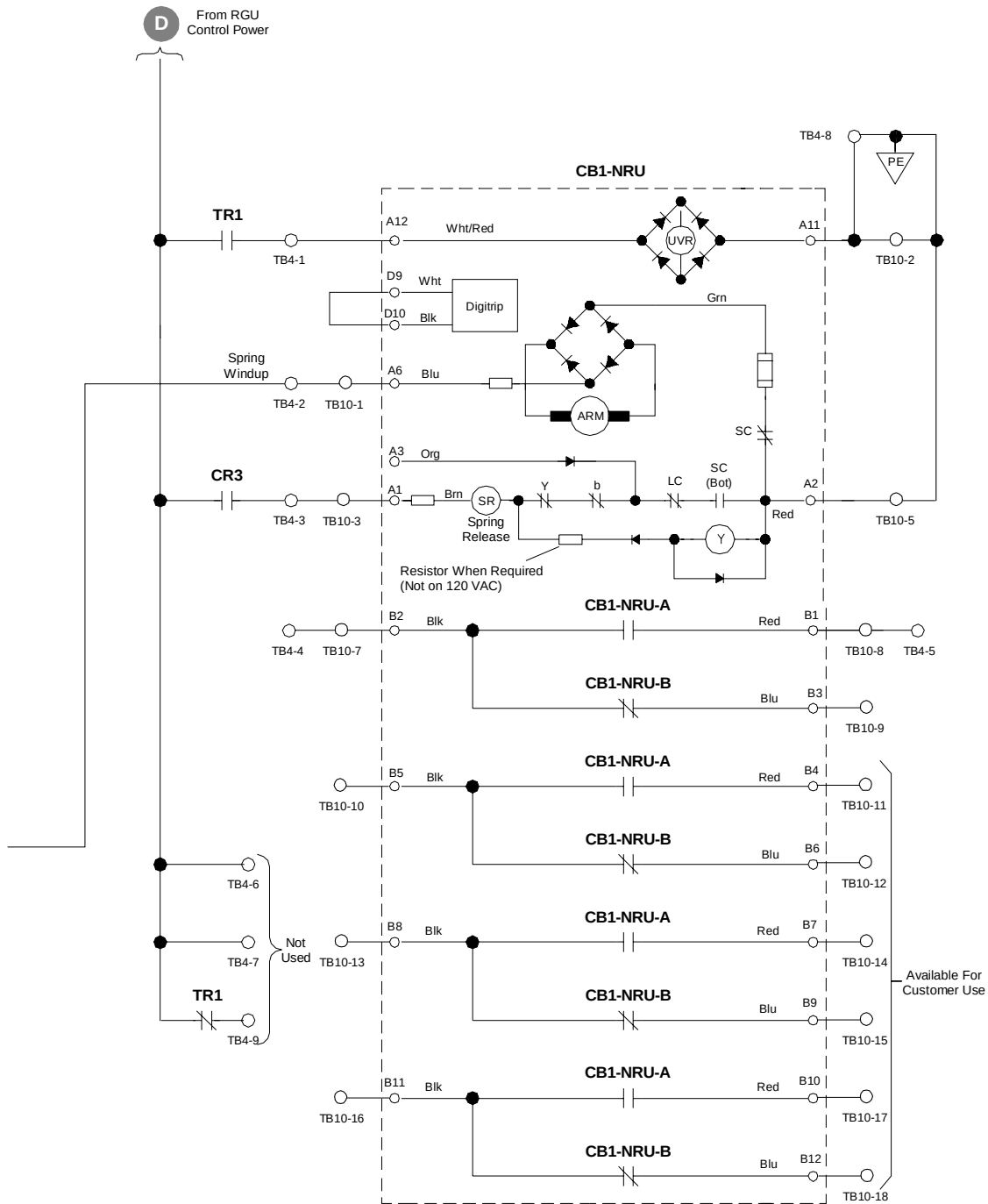
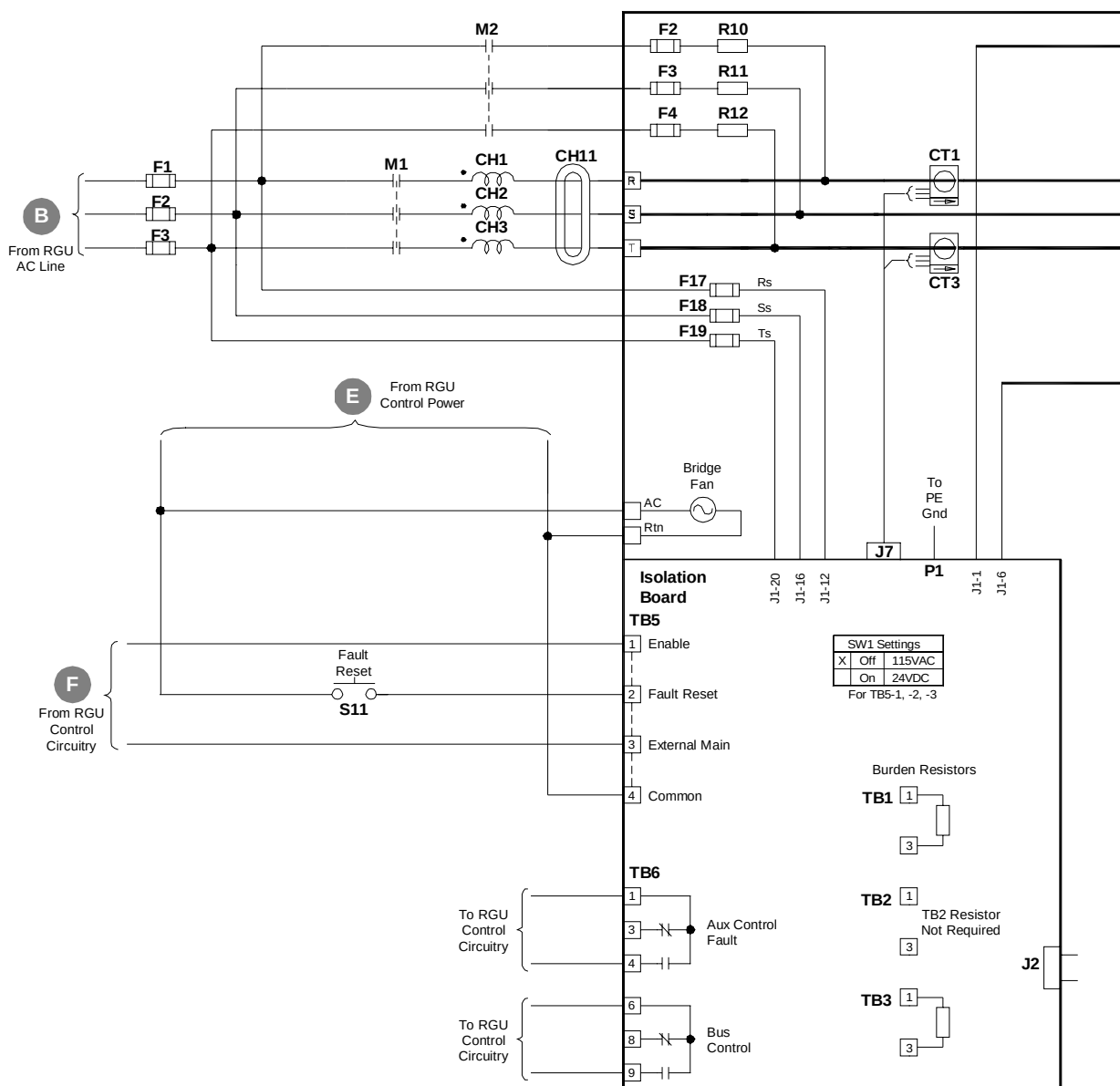
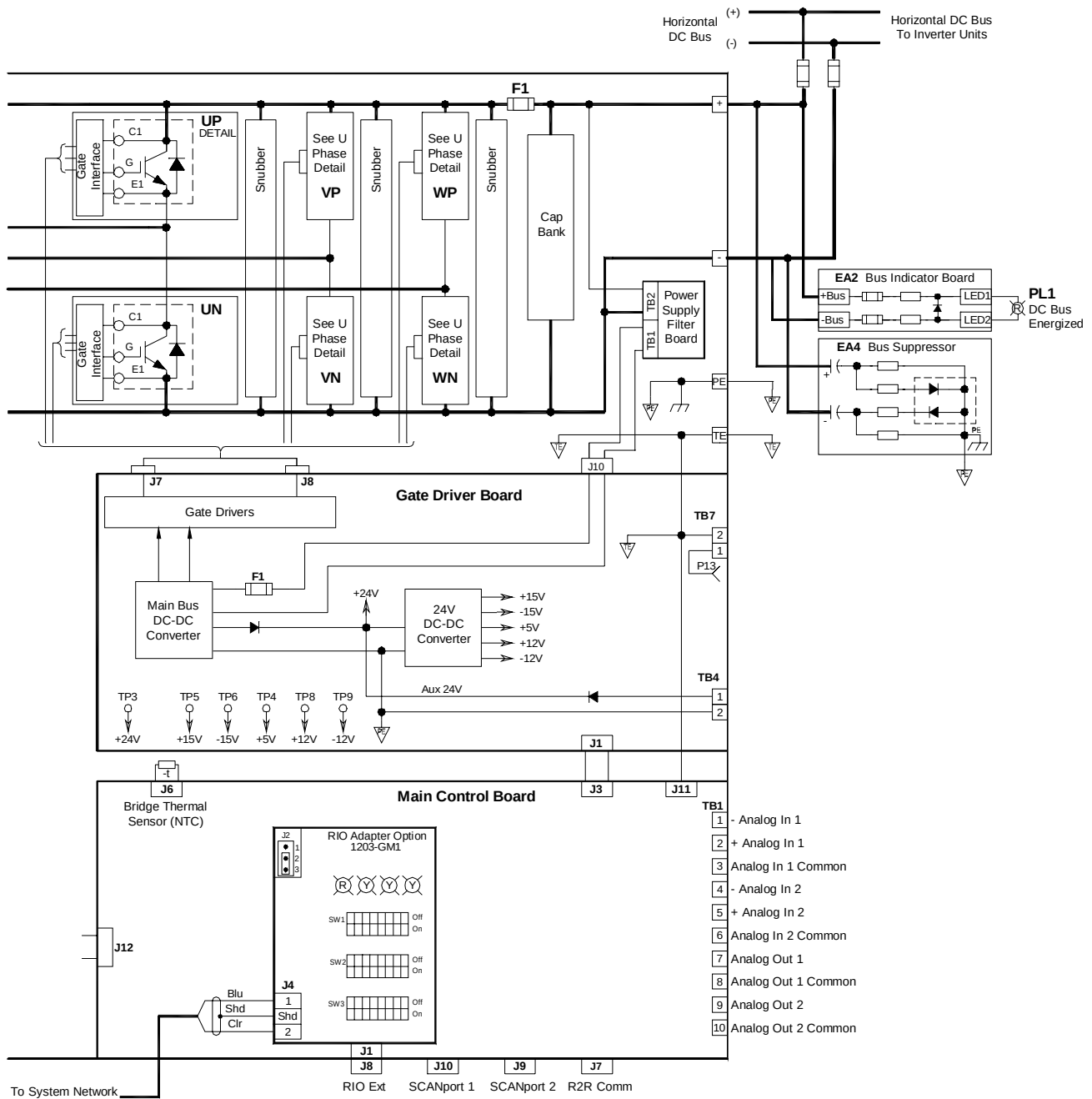


Figure 7.7
Schematics (cont.)





T3 and V3-Code Parallel Configurations

T3-Code Parallel Configuration

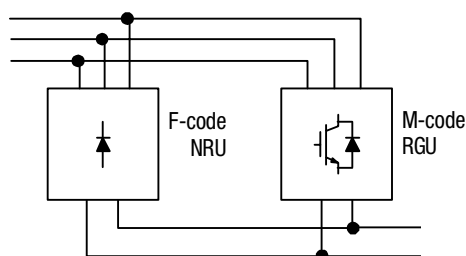
The T3-code parallel configuration is a common DC bus front-end unit consisting of an F-code NRU in parallel with a M-code RGU.

Figure 8.1
T3-Code Parallel Configuration—Information

T3-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2575	1321
460	2575	1599
575	2575	1994

T3-code Parallel Configuration



V3-Code Parallel Configuration

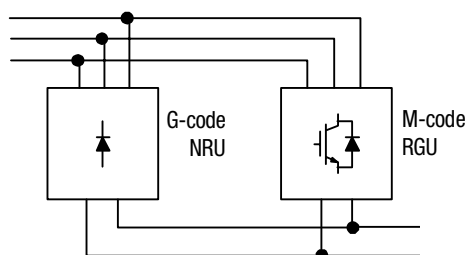
The V3-code parallel configuration is a common DC bus front-end unit consisting of an G-code NRU in parallel with a M-code RGU.

Figure 8.2
V3-Code Parallel Configuration—Information

V3-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	3000	1539
460	3000	1863
575	3000	2329

V3-code Parallel Configuration



Note: Information for the F-code NRU and G-code NRU can be found in publication 2364E-5.01. Information for the M-code RGU can be found in publication 2364F-5.01.

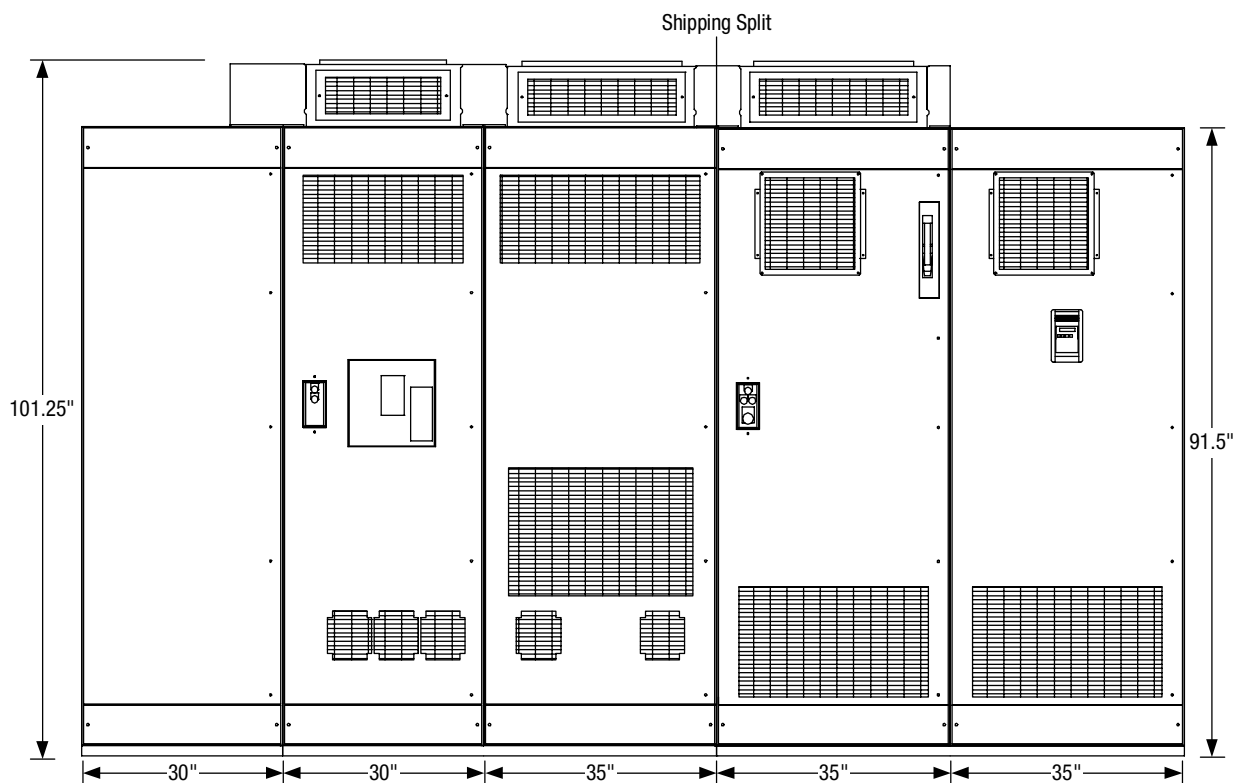
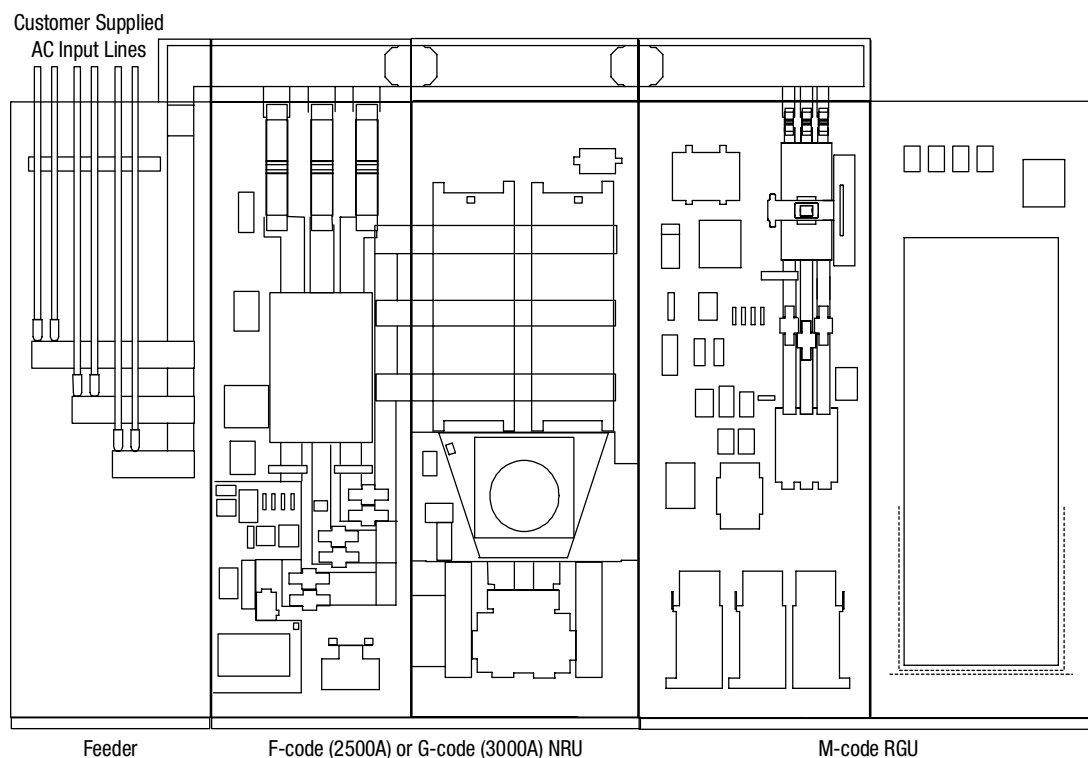
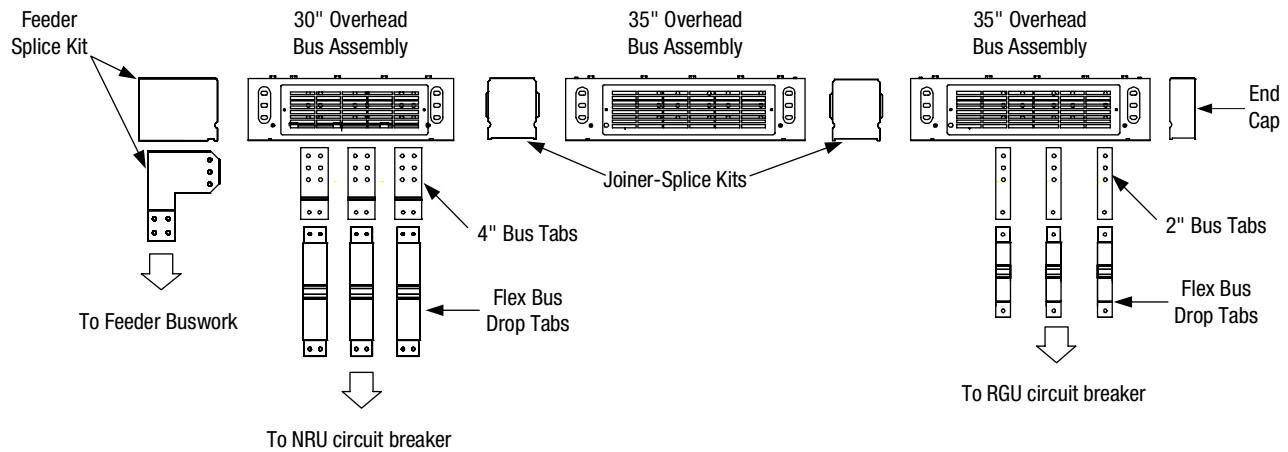
Component Layout**Figure 8.3
Enclosure Layout***Front View**Cutaway View*

Figure 8.4
Overhead Bus Assembly



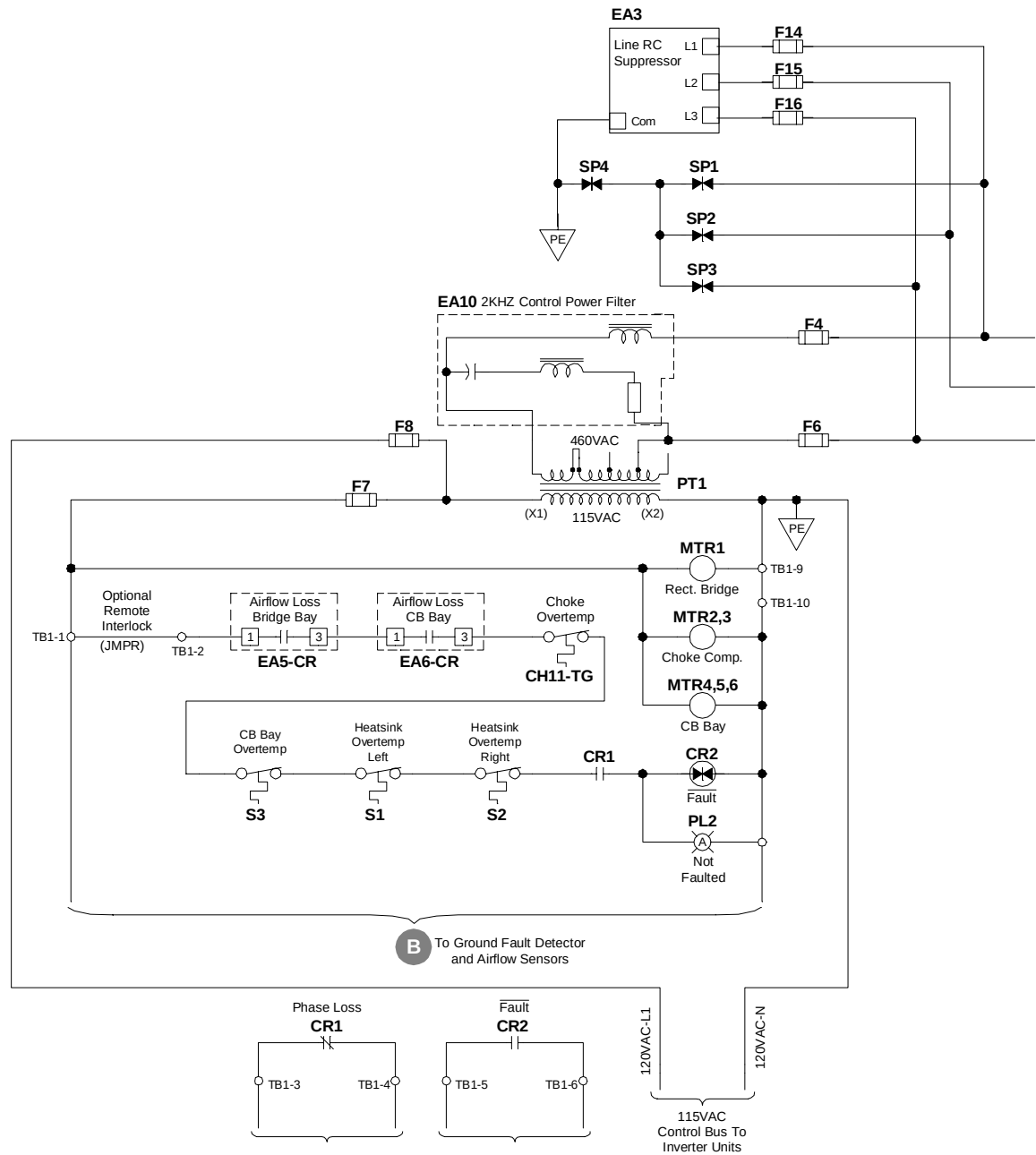
New and Revised NRU and RGU Components in the T3 and V3 Configurations

NRU	CB1	(T1 config) 2500A, SPB-frame with motor operator (V1 config) 3000A, SPB-frame with motor operator	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	Primary fuse for 10kVA control transformer (Opt 6P) 35A, KLDR (for 380V AC input) 30A, KLDR (for 460V AC input) 25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
	TB10	Control terminal block, 30A, 600V	
RGU	CR4	Precharge Lockout Relay (2NO/2NC)	
	F4, F6	Primary fuse for 5kVA transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	
	F21, F22 21A, 22A	DC bus fuses, 500A, 700V, 170M	
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
	Overhead bus assembly		

Schematics

Figure 8.5
Schematics

NRU



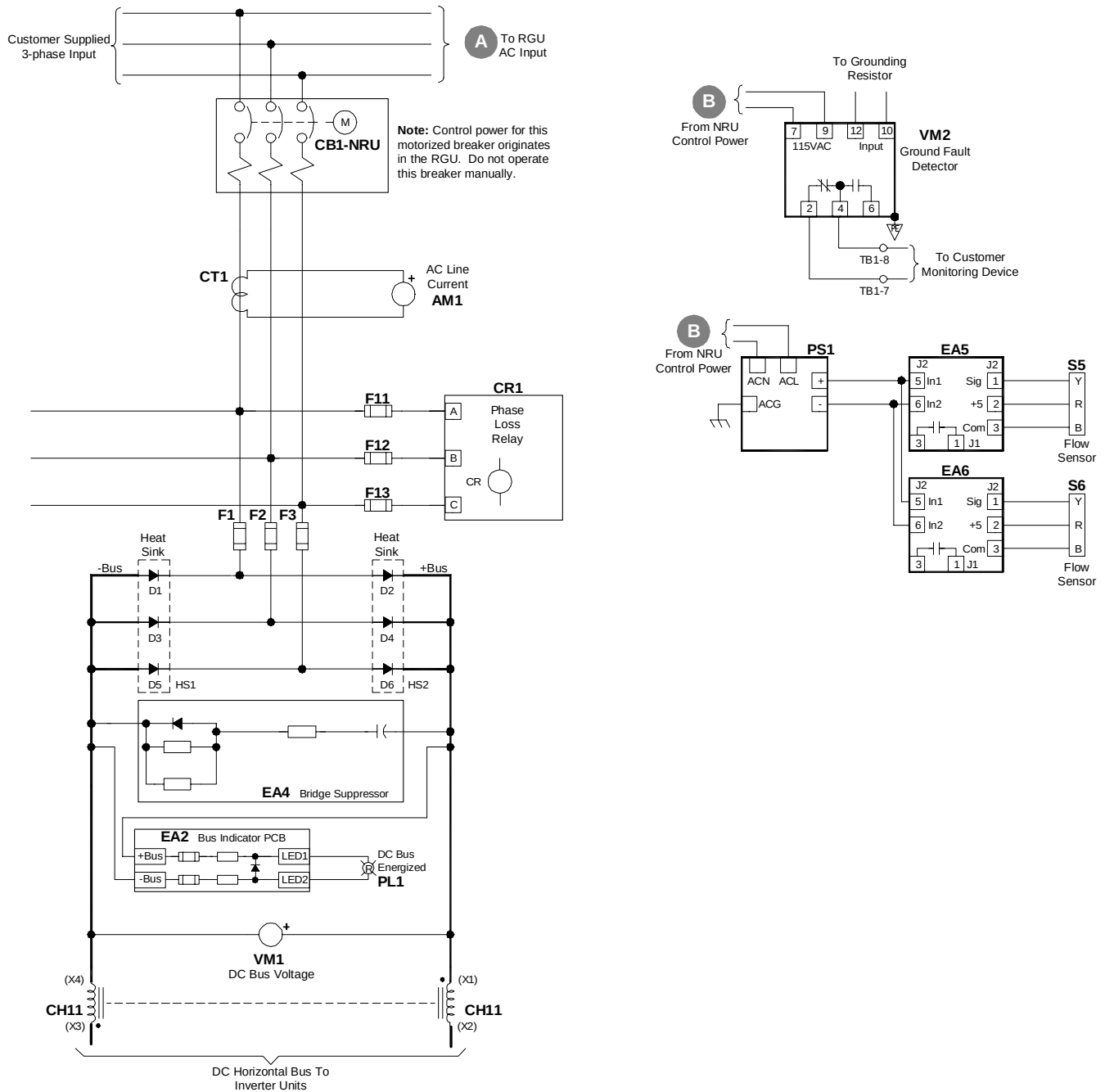
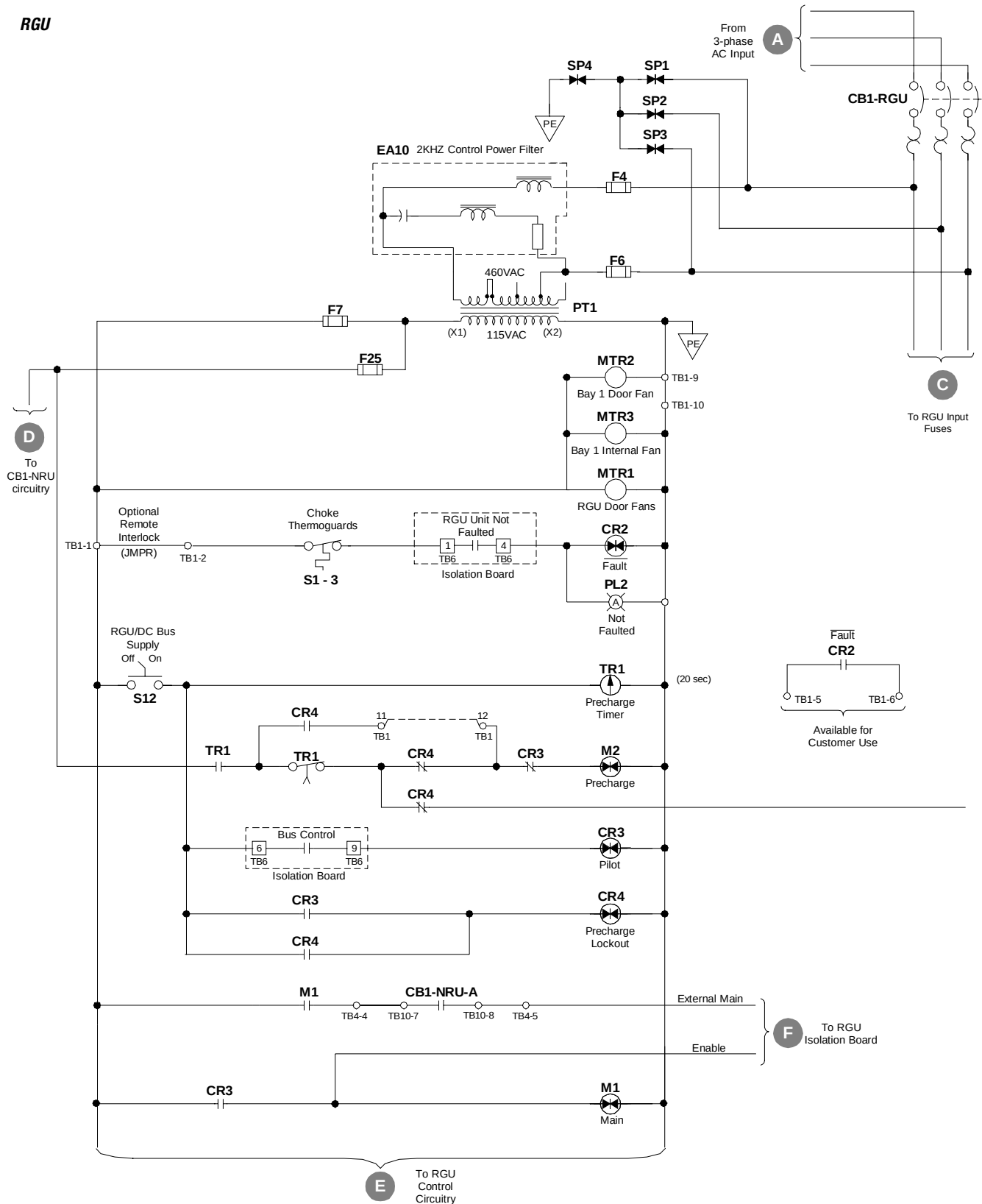


Figure 8.6
Schematics (cont.)



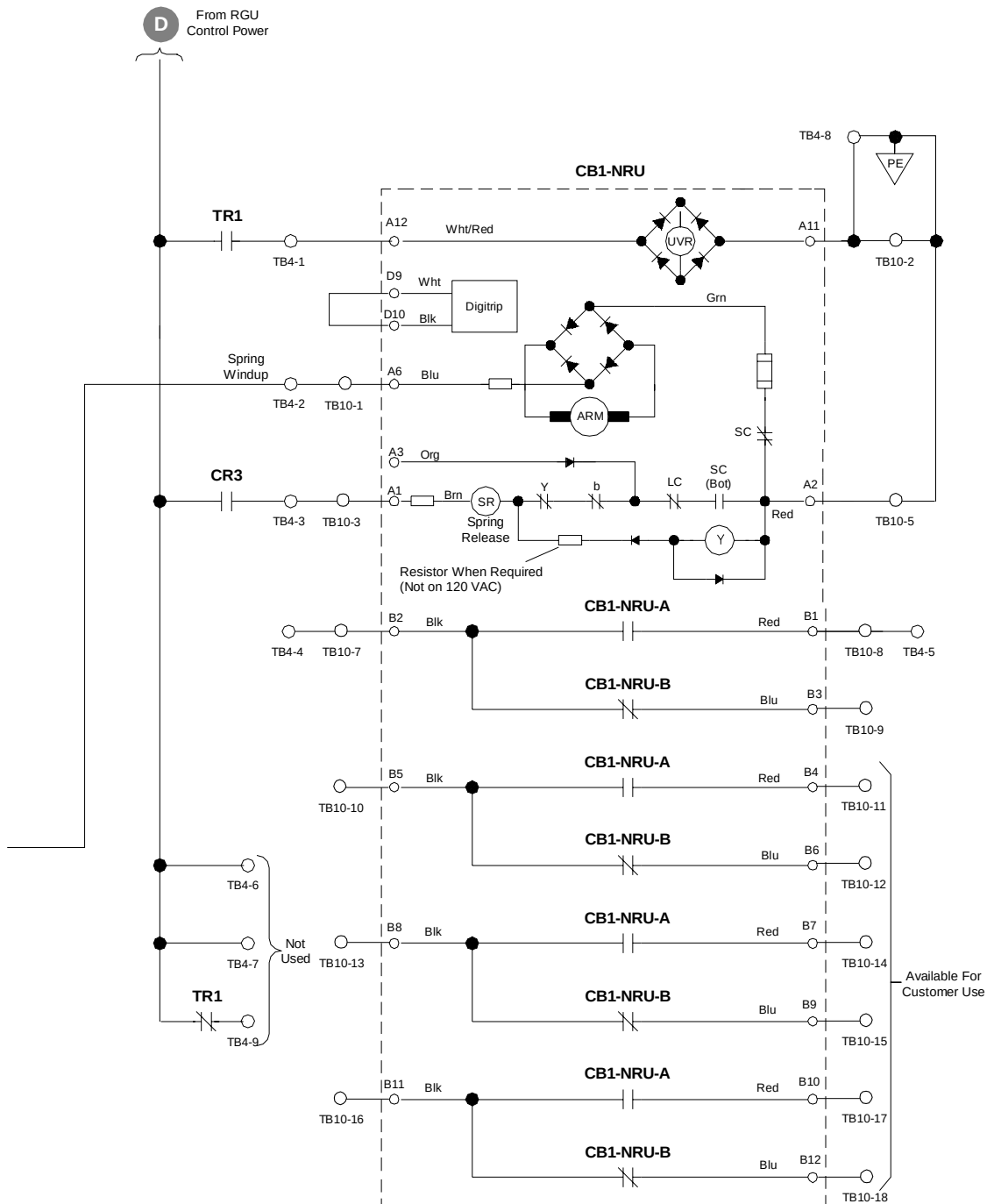
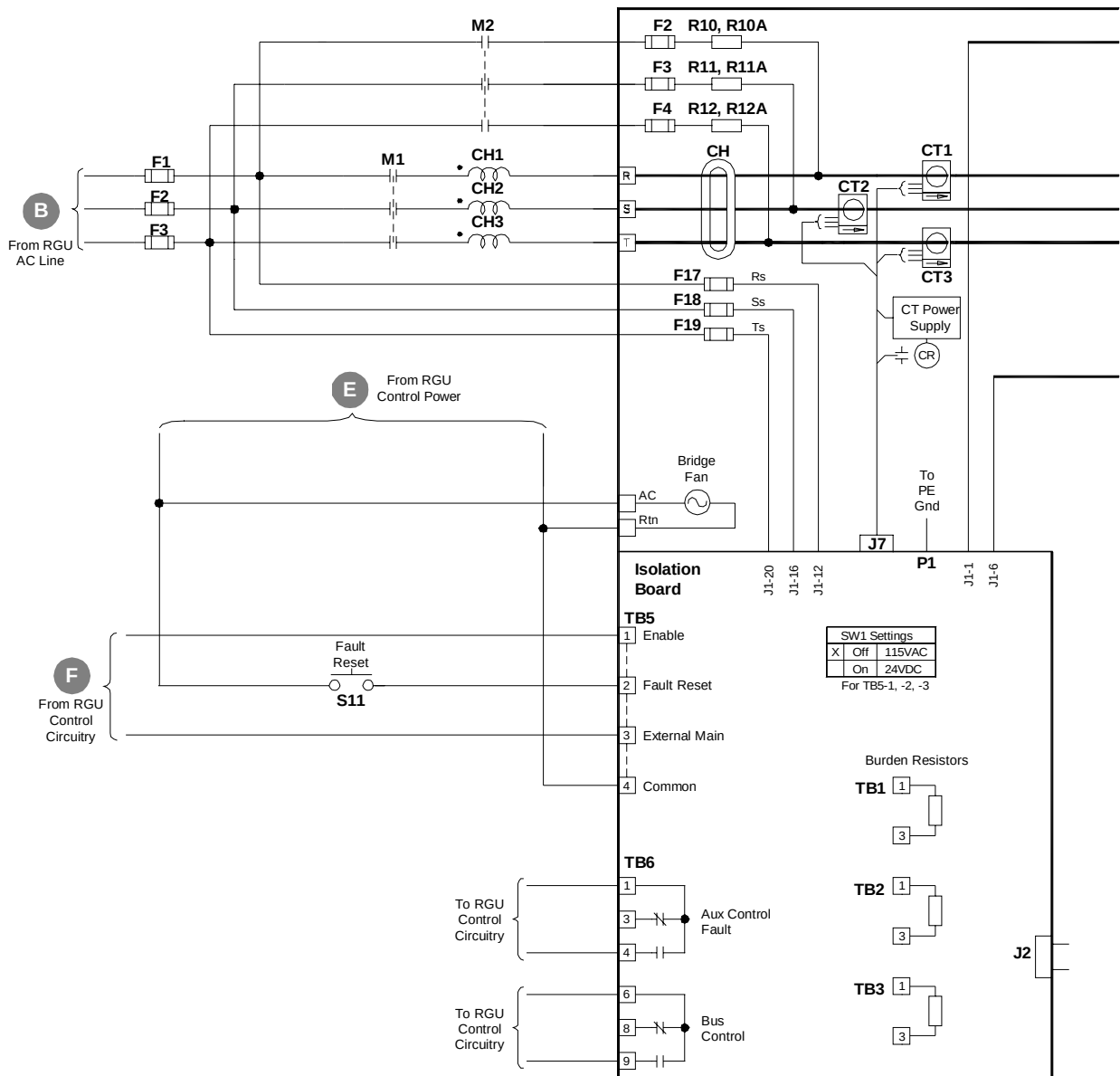
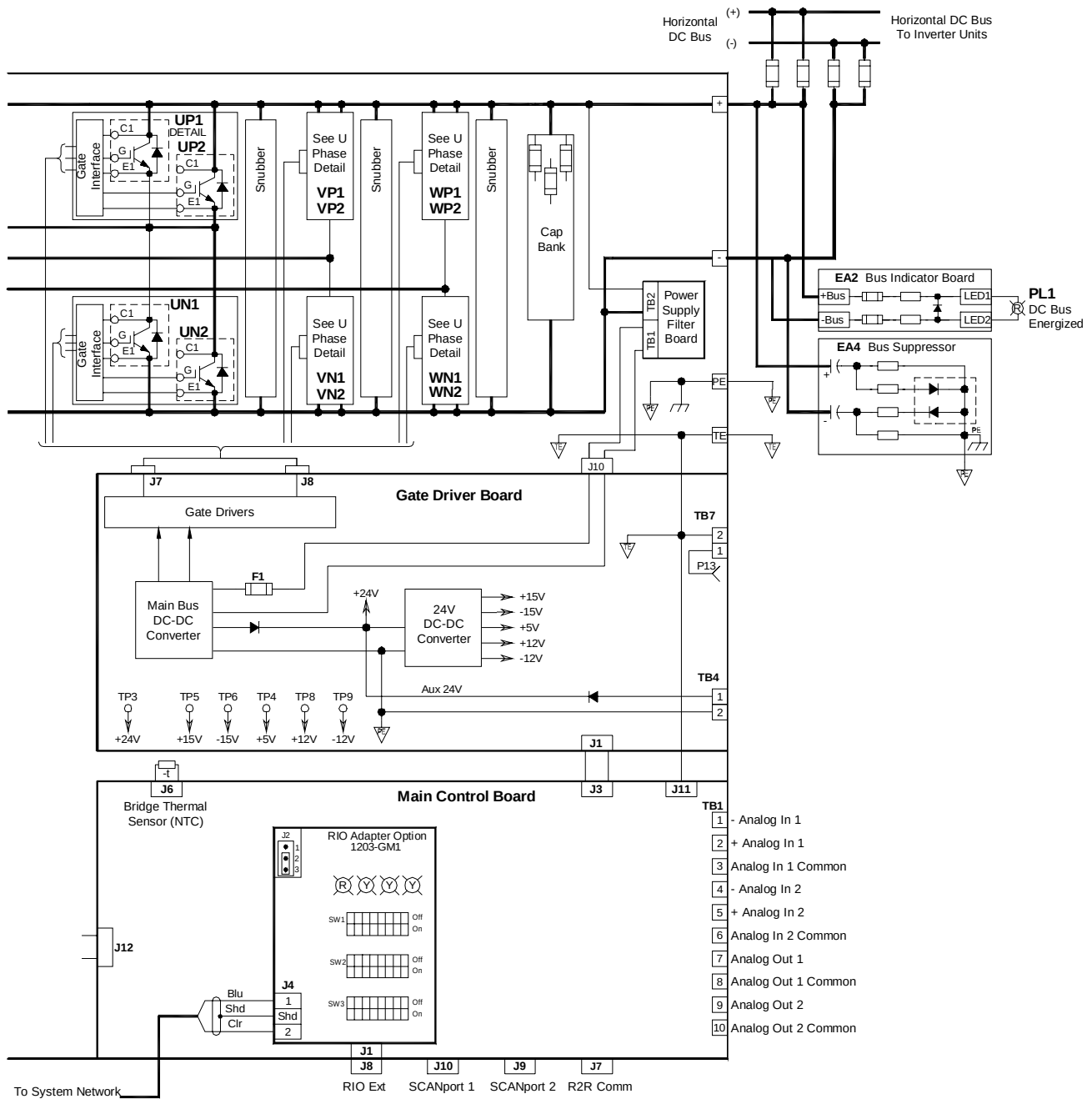


Figure 8.7
Schematics (cont.)





T4 and V4-Code Parallel Configurations

T4-Code Parallel Configuration

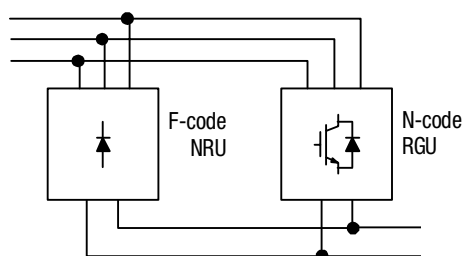
The T4-code parallel configuration is a common DC bus front-end unit consisting of an F-code NRU in parallel with a N-code RGU.

Figure 9.1
T4-Code Parallel Configuration—Information

T4-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2600	1334
460	2600	1615
575	2591	2012

T4-code Parallel Configuration



V4-Code Parallel Configuration

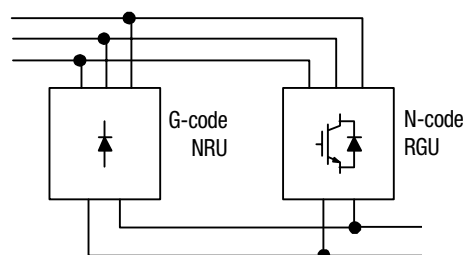
The V4-code parallel configuration is a common DC bus front-end unit consisting of an G-code NRU in parallel with a N-code RGU.

Figure 9.2
V4-Code Parallel Configuration—Information

V4-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	3000	1539
460	3000	1863
575	3000	2329

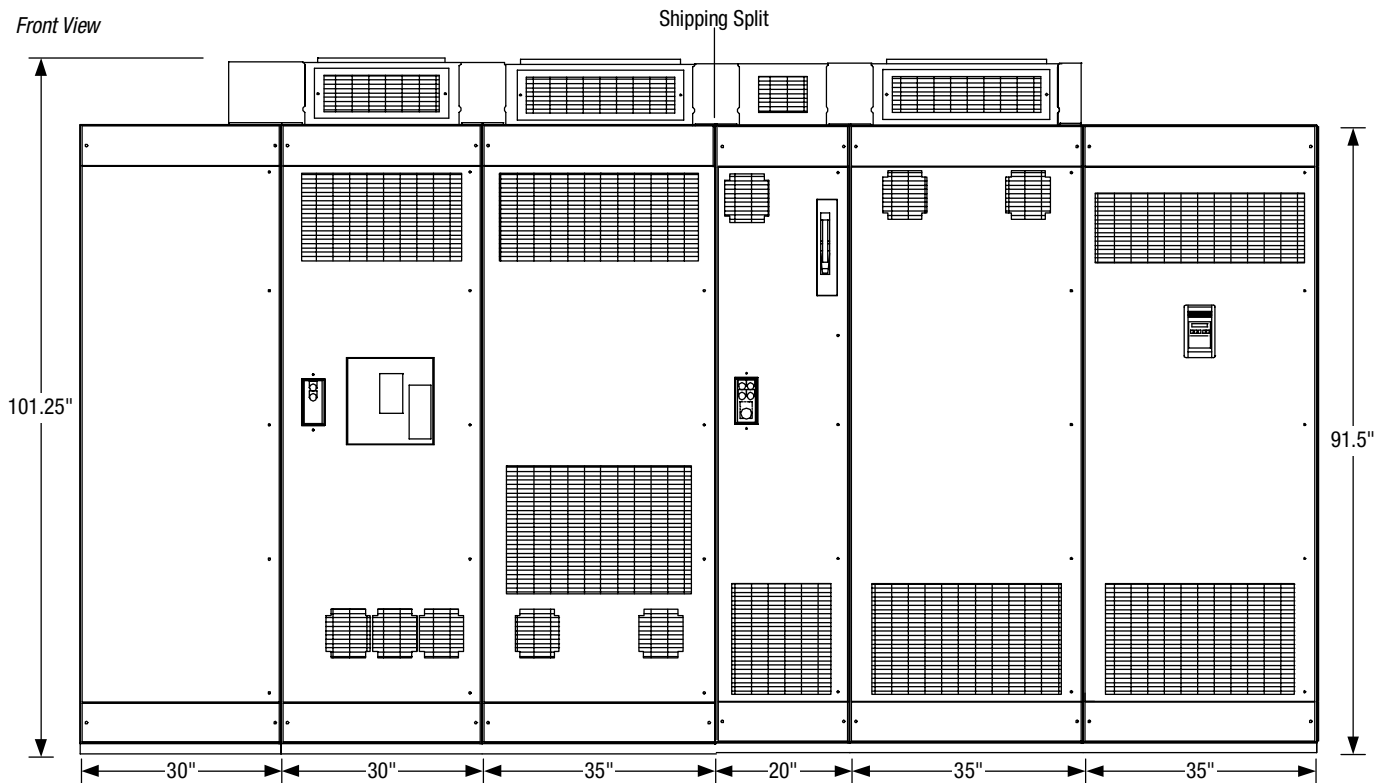
V4-code Parallel Configuration



Note: Information for the F-code NRU and G-code NRU can be found in publication 2364E-5.01. Information for the N-code RGU can be found in publication 2364F-5.01.

Component Layout

Figure 9.3
Enclosure Layout



Cutaway View

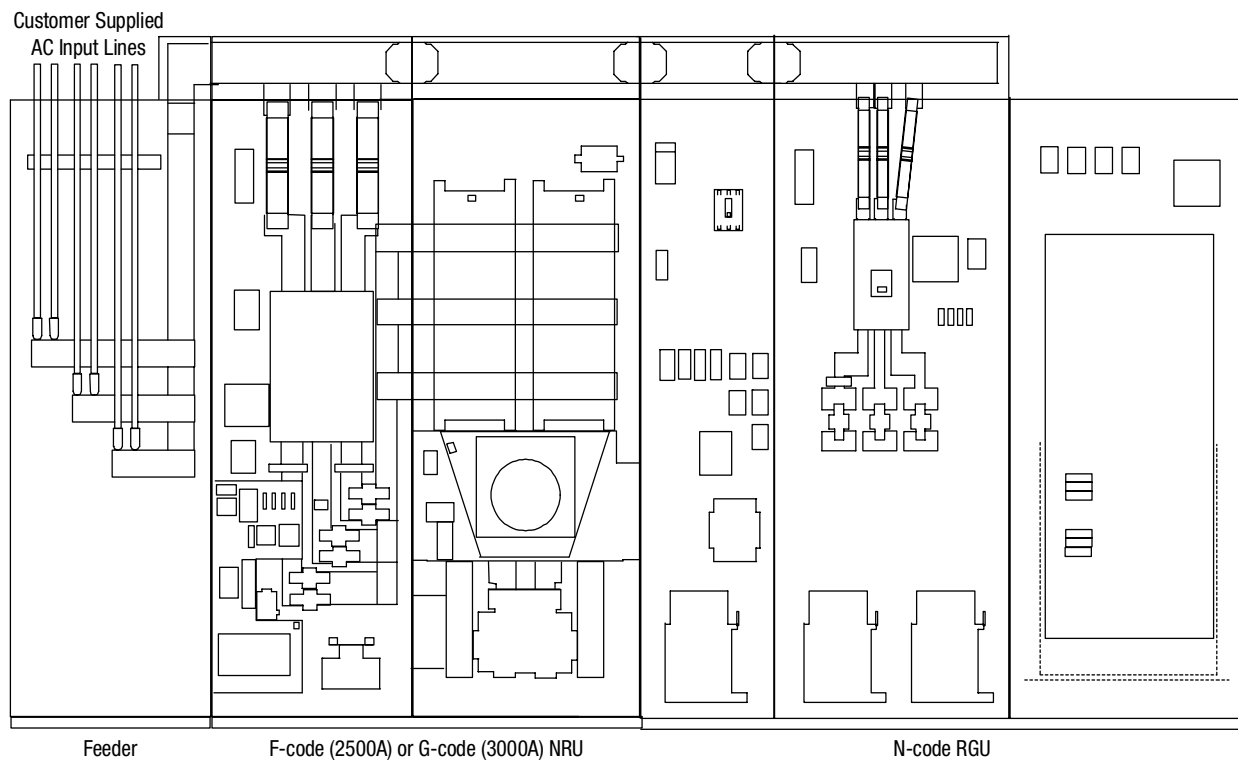
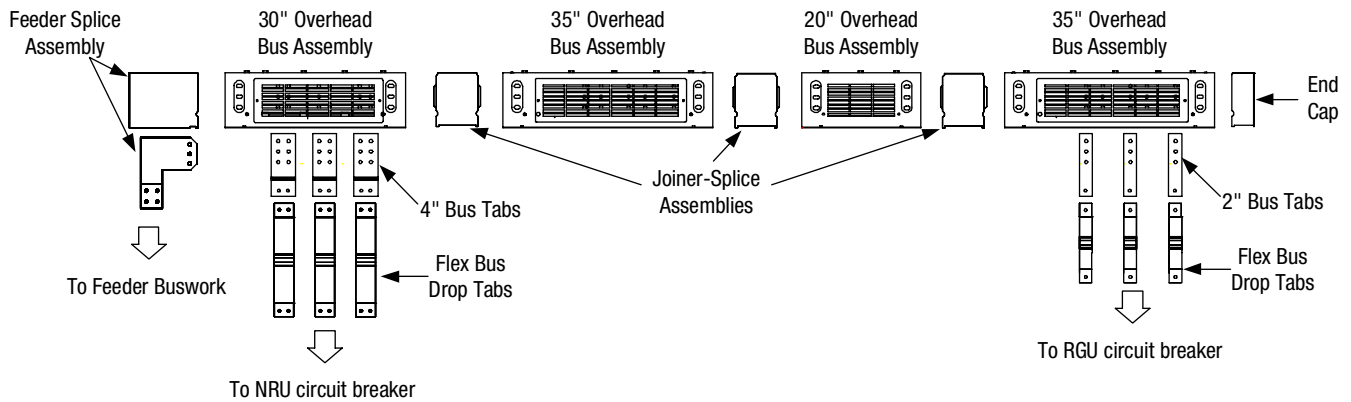


Figure 9.4
Overhead Bus Assembly



New and Revised NRU and RGU Components in the T4 and V4 Configurations

NRU	CB1	(T1 config) 2500A, SPB-frame with motor operator (V1 config) 3000A, SPB-frame with motor operator	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	
	TB10	Control terminal block, 30A, 600V	
		Control power transformer, 10kVA (Opt 6P)	

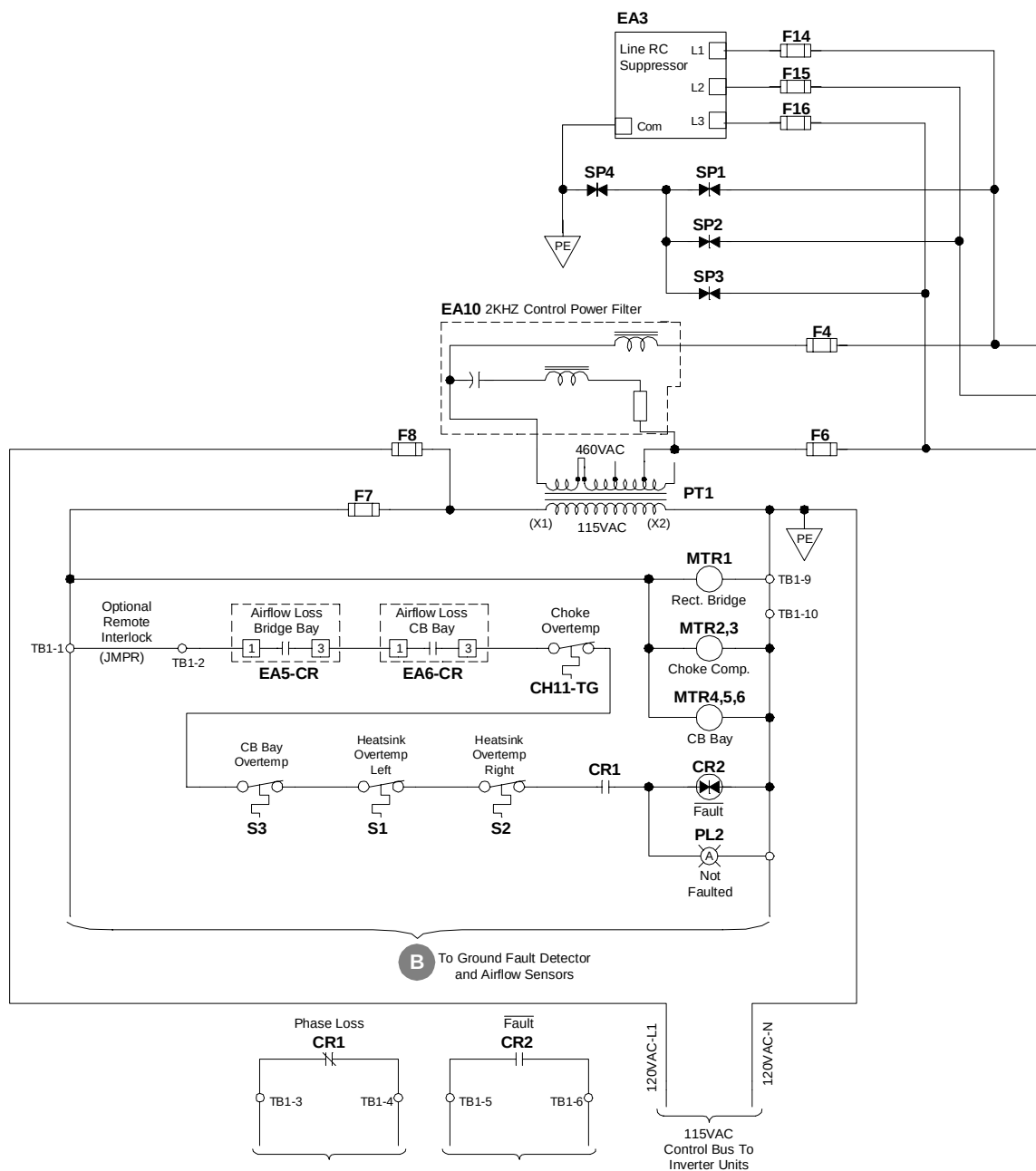
RGU	CR3	Pilot relay (2NO/2NC) with aux contact (1NO/1NC)
	CR4	Precharge Lockout Relay (2NO/2NC)
	F4, F6	Primary fuse for 5kVA transformer
		25A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)
	F21, F22	DC bus fuses, 500A, 700V, 170M
	21A, 22A	
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR
	PT1	Control power transformer, 5kVA
	TR1	Timer relay (3NO/1NC)
	TB4	Control Terminal block, 30A, 600V

Overhead bus assembly

Schematics

Figure 9.5
Schematics

NRU



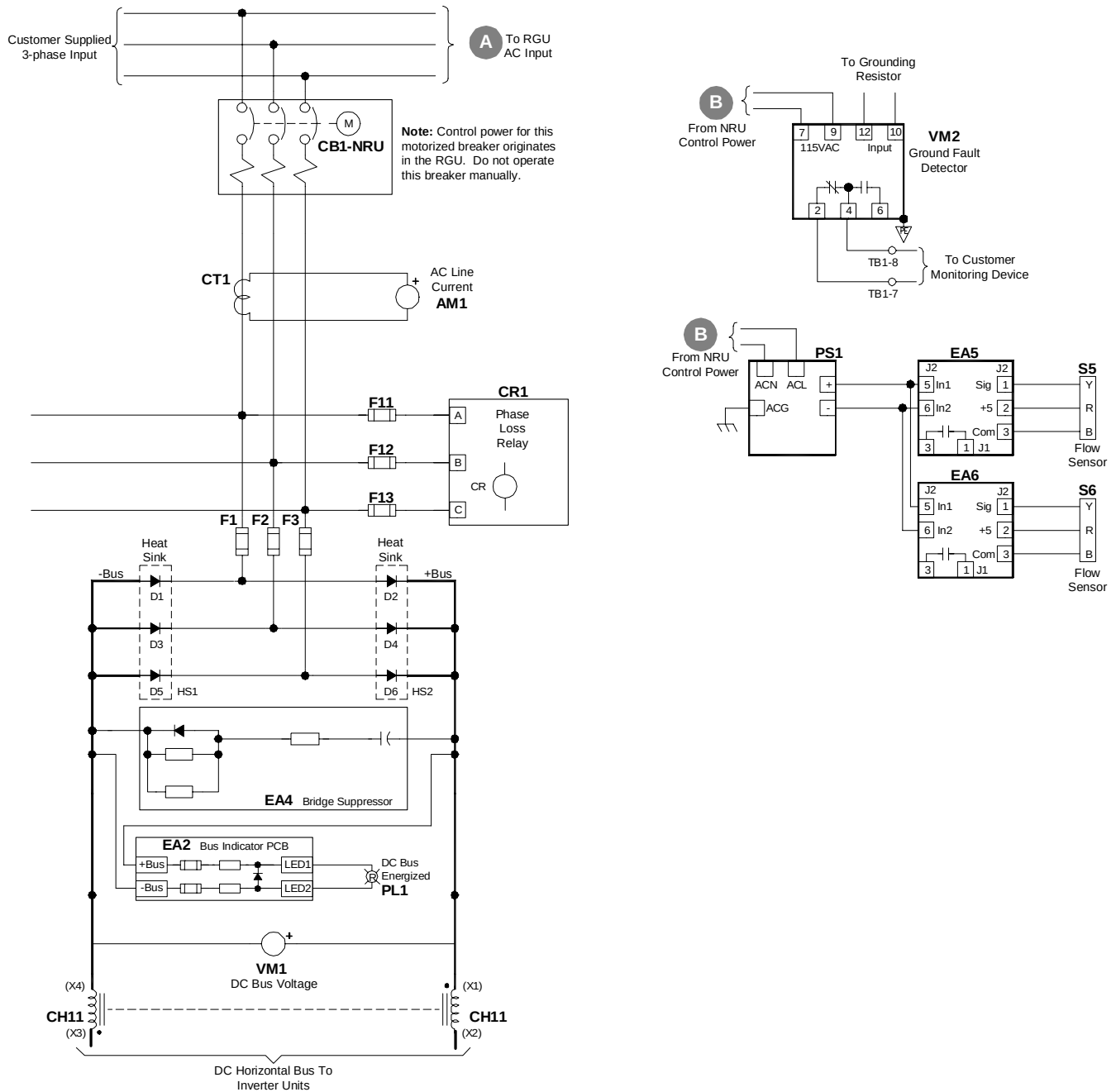
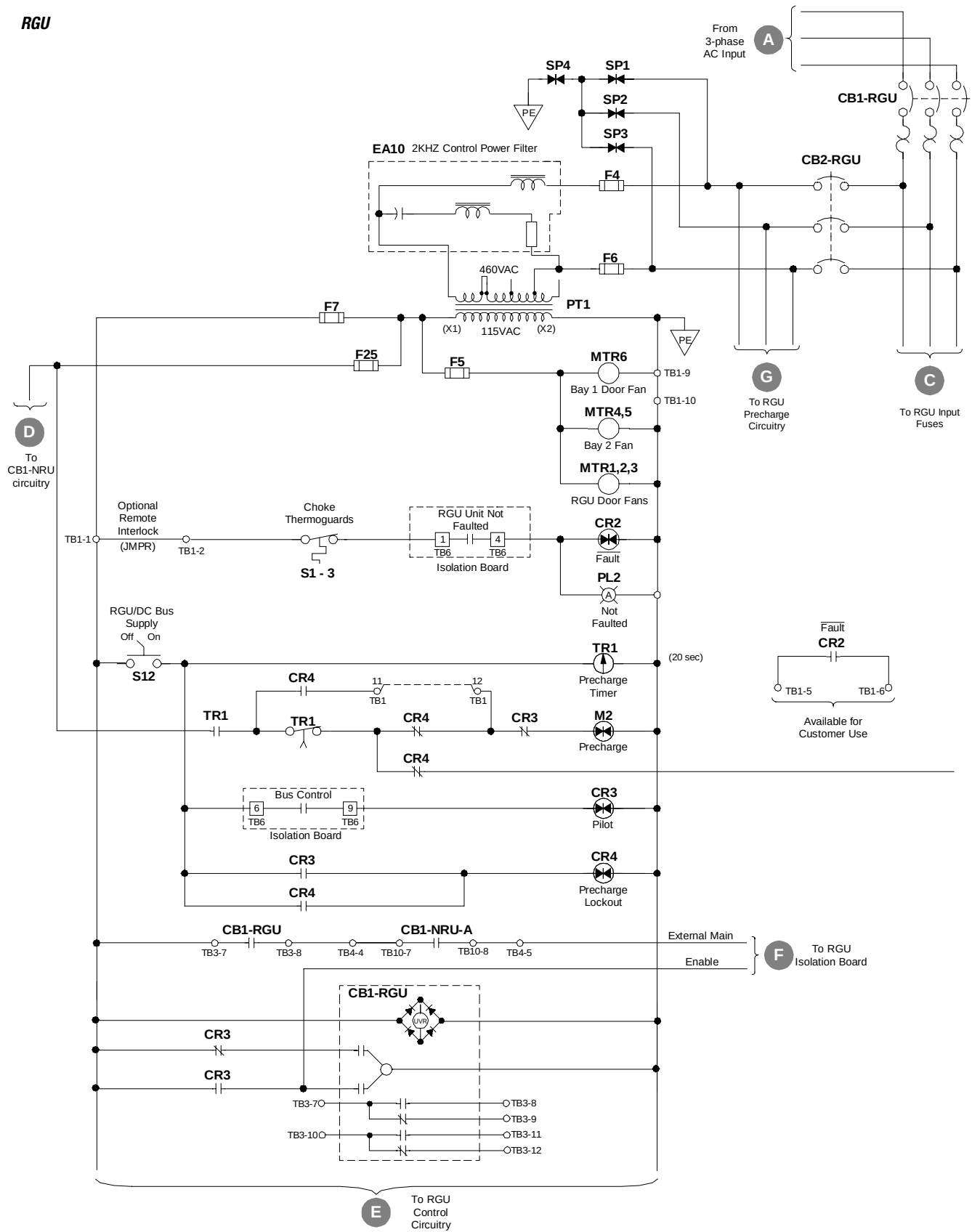


Figure 9.6
Schematics (cont.)

RGU



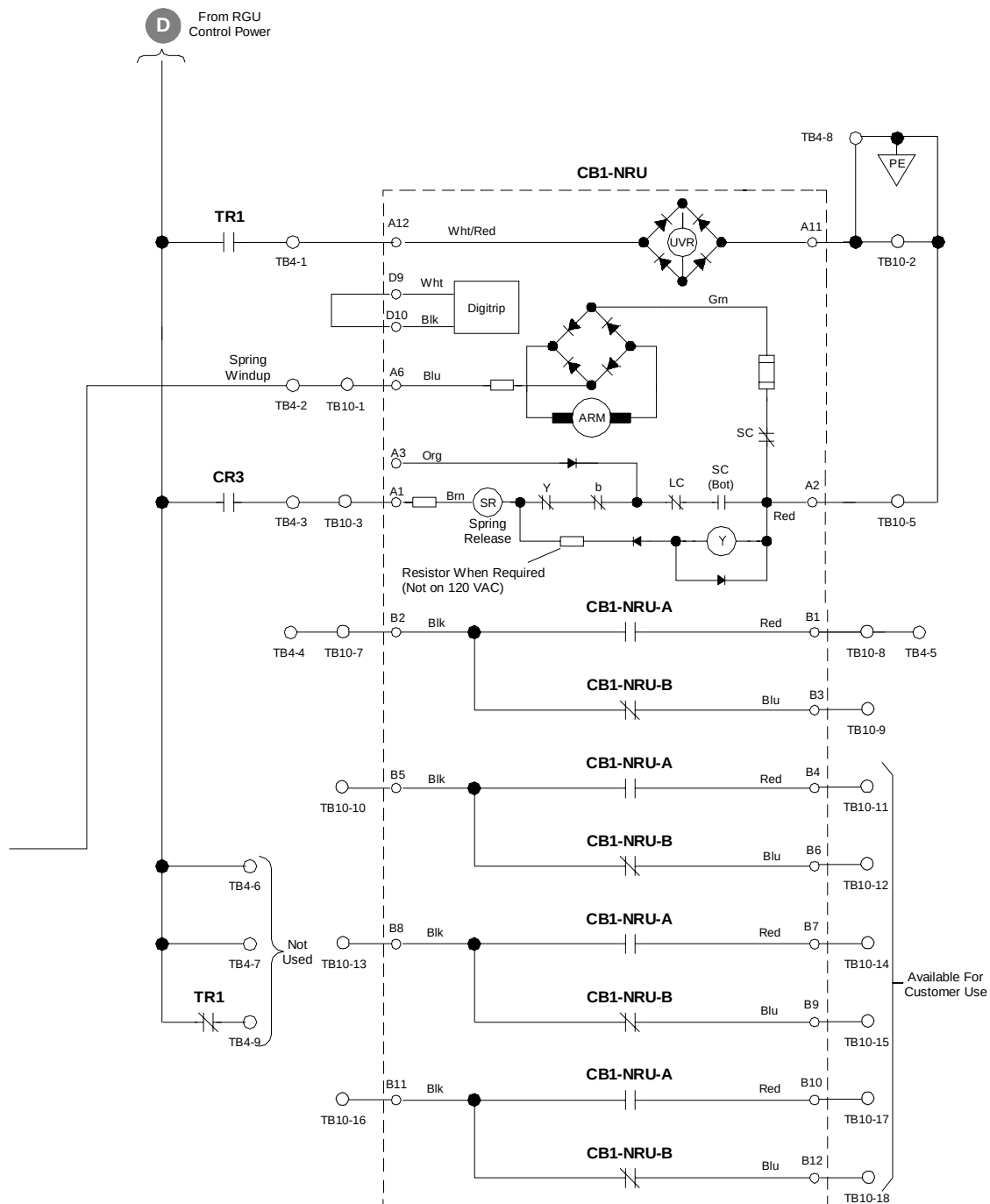
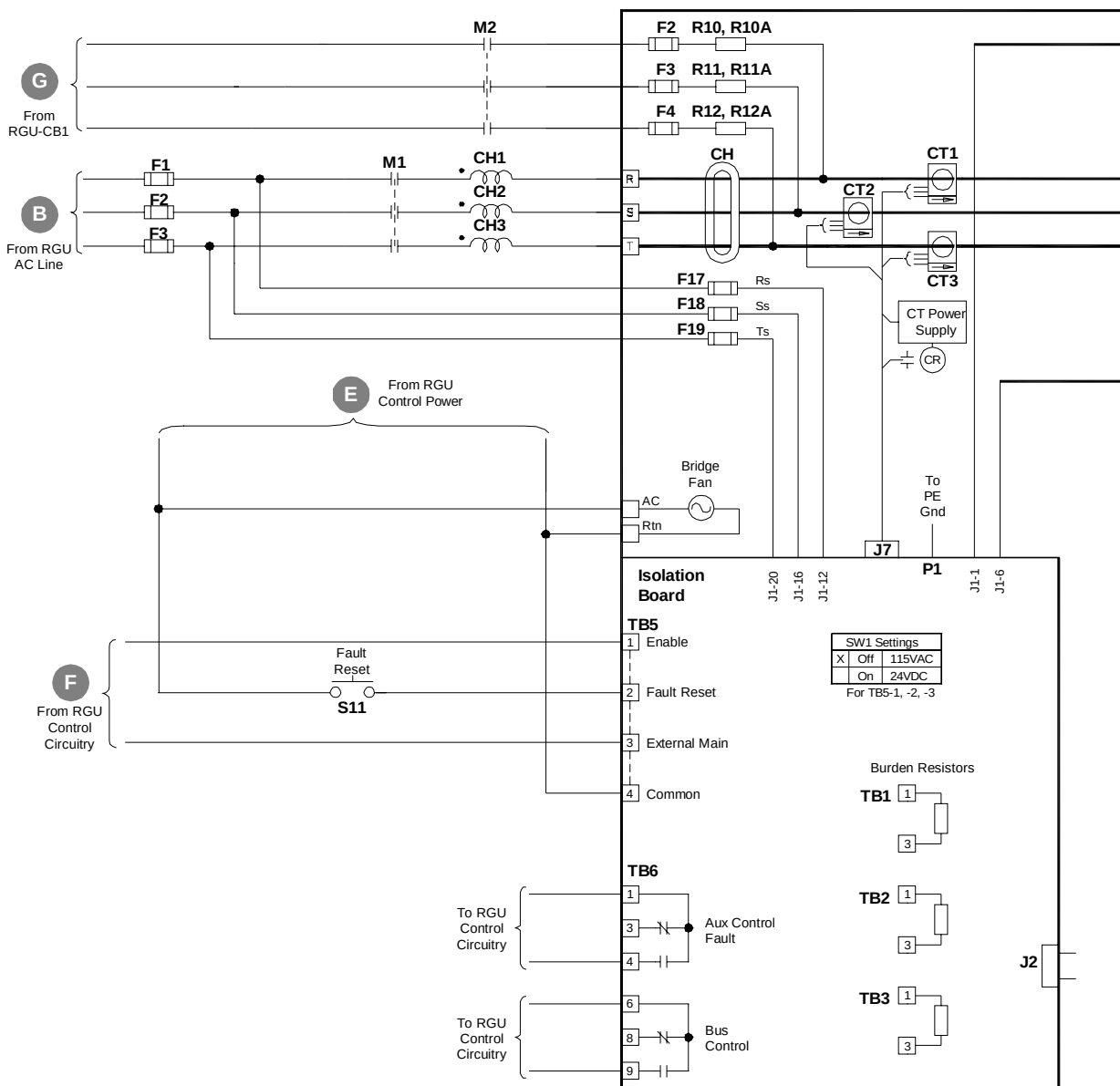
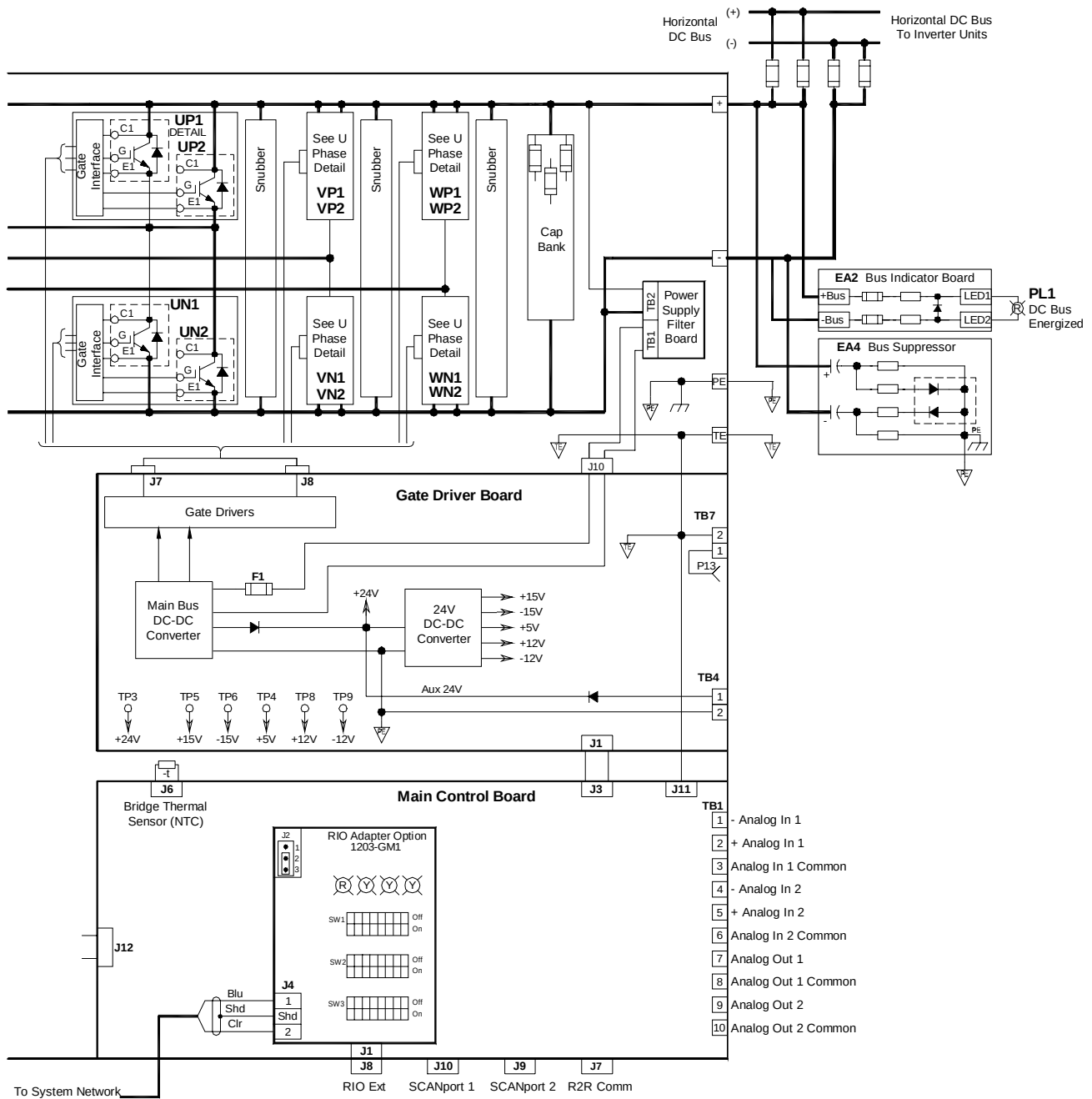


Figure 9.7
Schematics (cont.)





T5 and V5-Code Parallel Configurations

T5-Code Parallel Configuration

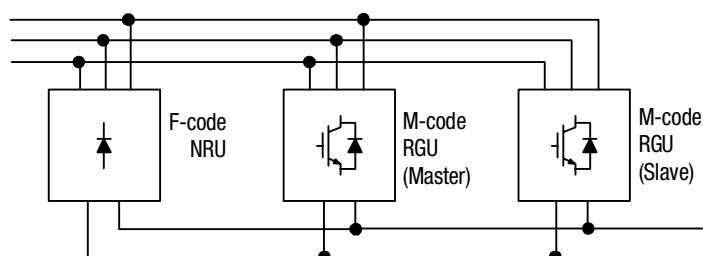
The T5-code parallel configuration is a common DC bus front-end unit consisting of an F-code NRU in parallel with two M-code RGUs.

Figure 10.1
T5-Code Parallel Configuration—Information

T5-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2649	1359
460	2650	1677
575	2637	2083

T5-code Parallel Configuration



V5-Code Parallel Configuration

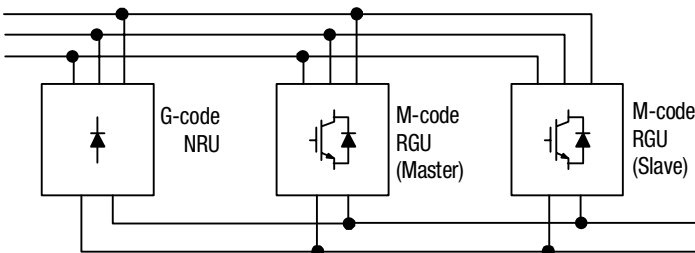
The V5-code parallel configuration is a common DC bus front-end unit consisting of an G-code NRU in parallel with two M-code RGUs.

Figure 10.2
V5-Code Parallel Configuration—Information

V5-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	3000	1539
460	3000	1863
575	3000	2329

V5-code Parallel Configuration



Note: Information for the F-code NRU and G-code NRU can be found in publication 2364E-5.01. Information for the M-code RGU can be found in publication 2364F-5.01.

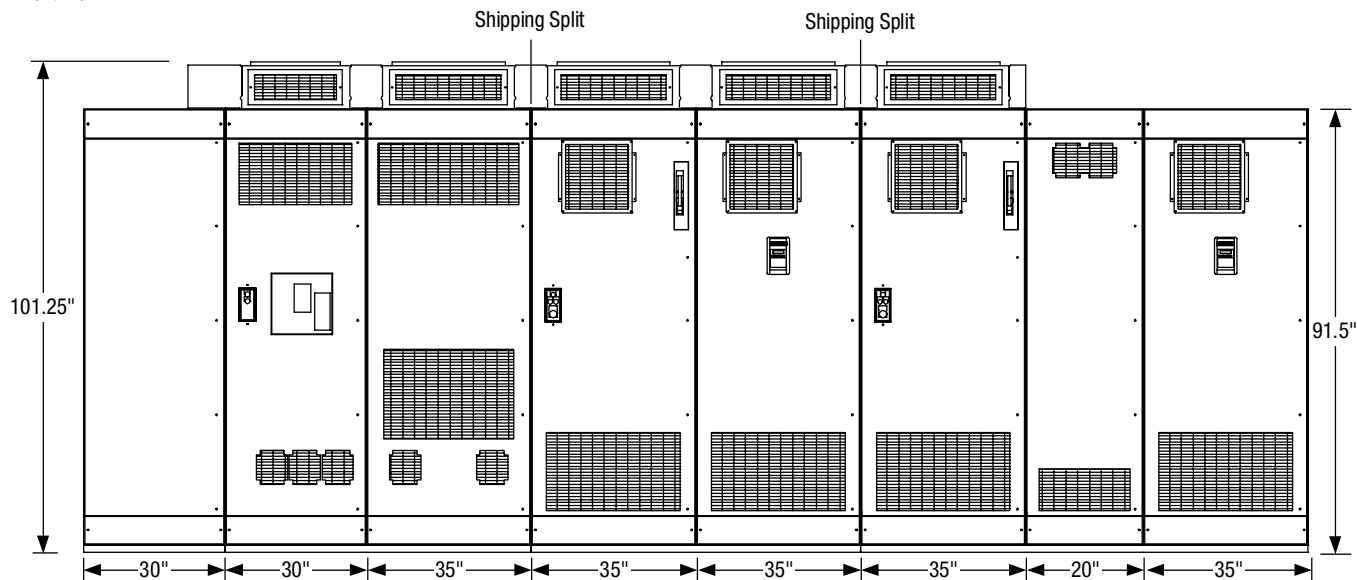
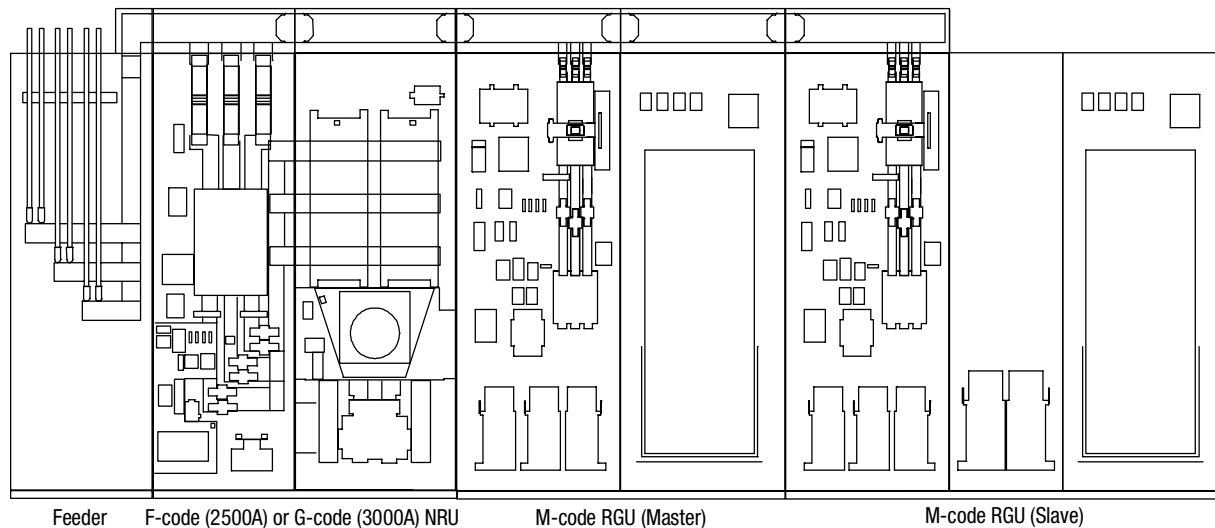
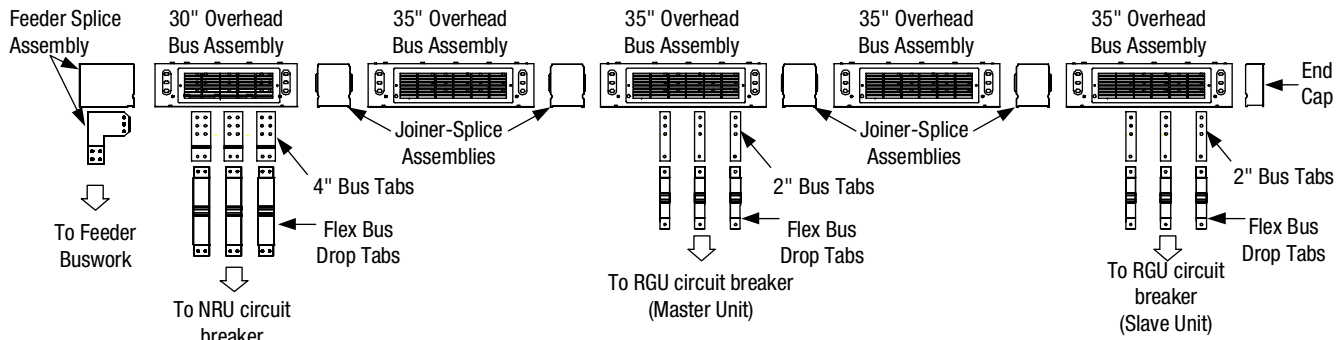
Component Layout**Figure 10.3
Enclosure Layout***Front View**Cutaway View*Customer Supplied
AC Input Lines

Figure 10.4
Overhead Bus Assembly



New and Revised NRU and RGU Components in the T5 and V5 Configurations

NRU	CB1	(T1 config) 2500A, SPB-frame with motor operator (V1 config) 3000A, SPB-frame with motor operator	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	Primary fuse for 10kVA control transformer (Opt 6P) 35A, KLDR (for 380V AC input) 30A, KLDR (for 460V AC input) 25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
	TB10	Control terminal block, 30A, 600V	
RGU (master)	CR3	Pilot relay (2NO/2NC) with aux contact (1NO/1NC)	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
RGU (slave)	CH21	Common Mode Choke, 600A, 4mH	
	CR3	Pilot relay (2NO/2NC) with aux contact (1NO/1NC)	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer 25A, KLDR (for 380V AC input) 20A, KLDR (for 460V AC input) 17.5A, KLDR (for 575V AC input)	
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
		Fiber optic cable, 26', HP HFBR connector	
		Overhead bus assembly	

Figure 10.5 Schematics

The diagram illustrates the 115VAC Control Bus To Inverter Units. It shows the power distribution from a 460VAC source through a transformer (PT1) to a 115VAC bus. The bus is protected by fuses (F1-F8) and includes various components like switches (S1-S3), relays (CR1, CR2), and sensors (EA5-CR, EA6-CR). It also shows a fault detection system (B) and a ground fault detector (CR1, CR2).

Key Components and Connections:

- Power Source:** 460VAC input to transformer PT1.
- Transformer PT1:** Steps down 460VAC to 115VAC (X1, X2).
- 115VAC Bus:** Distributes power to various components.
- Fuses:** F1, F2, F3, F4, F5, F6, F7, F8 for protection.
- Switches:** S1, S2, S3 for manual control.
- Relays:** CR1, CR2 for control logic.
- Sensors:** EA5-CR, EA6-CR for airflow loss detection.
- Fault Detection:** CR1, CR2 for phase loss and fault detection.
- Ground Fault Detector:** CR1, CR2 for ground fault detection.

Legend:

- CR1:** Phase Loss
- CR2:** Fault
- 115VAC:** Control Bus To Inverter Units

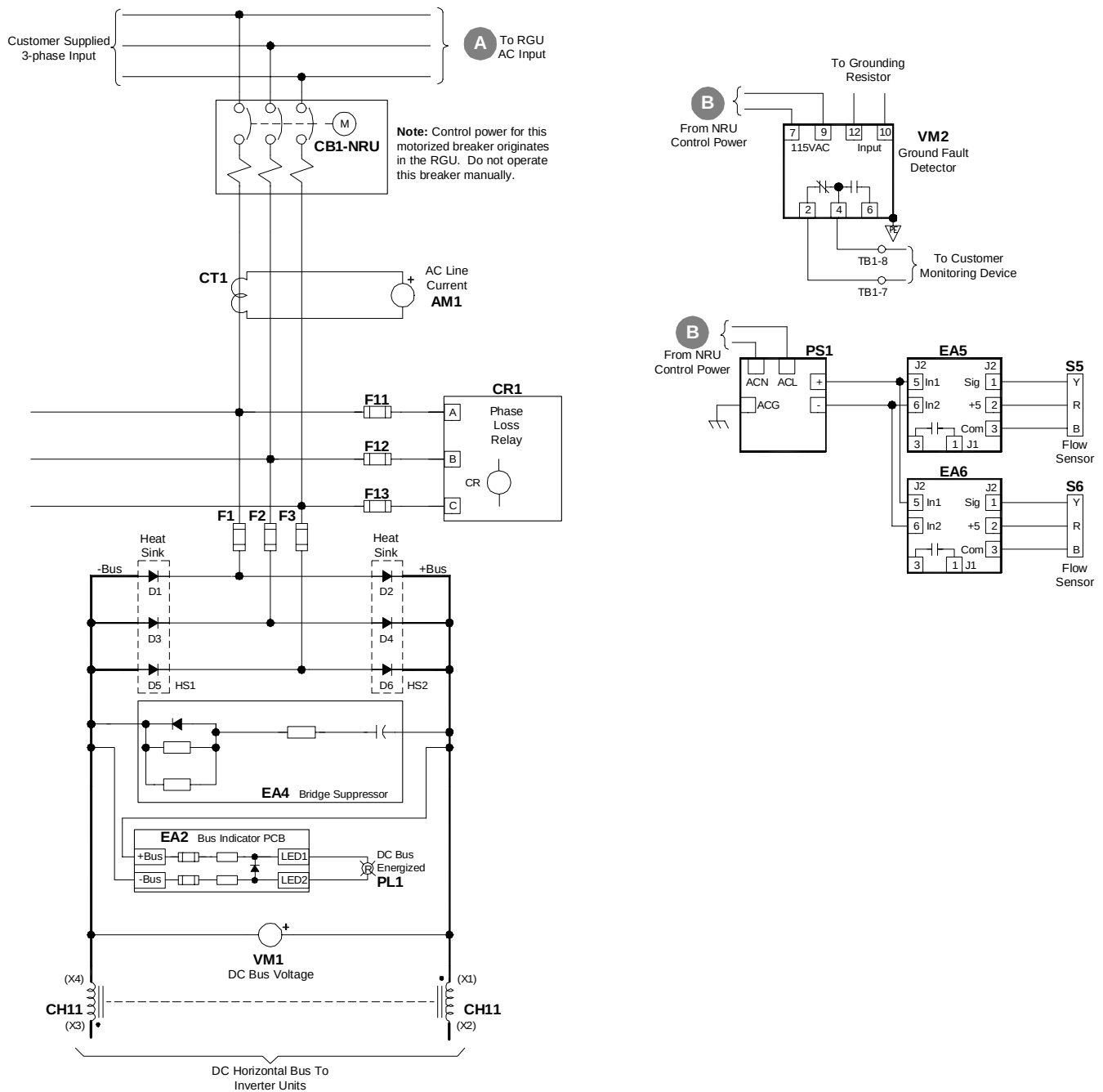
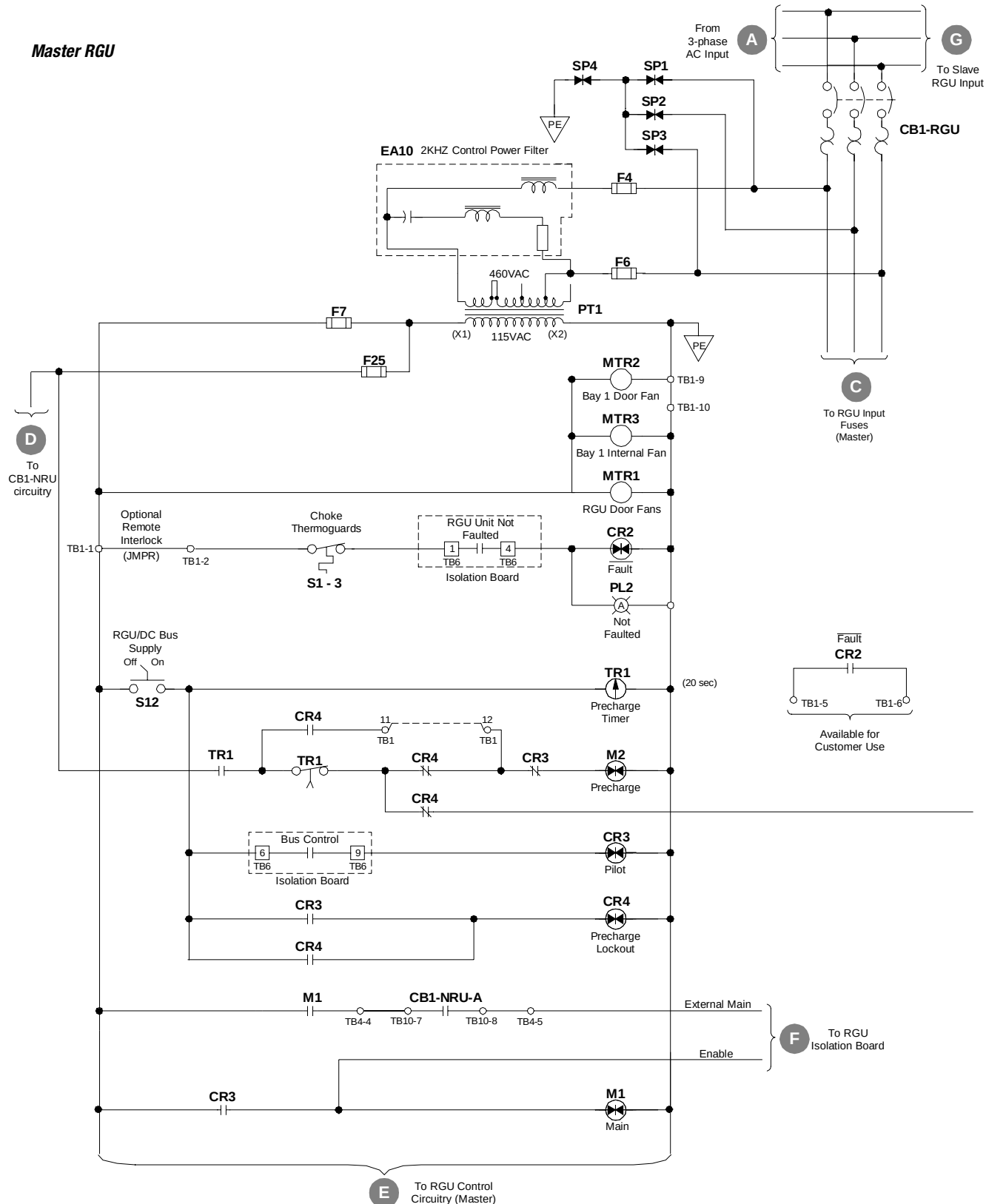


Figure 10.6
Schematics (cont.)



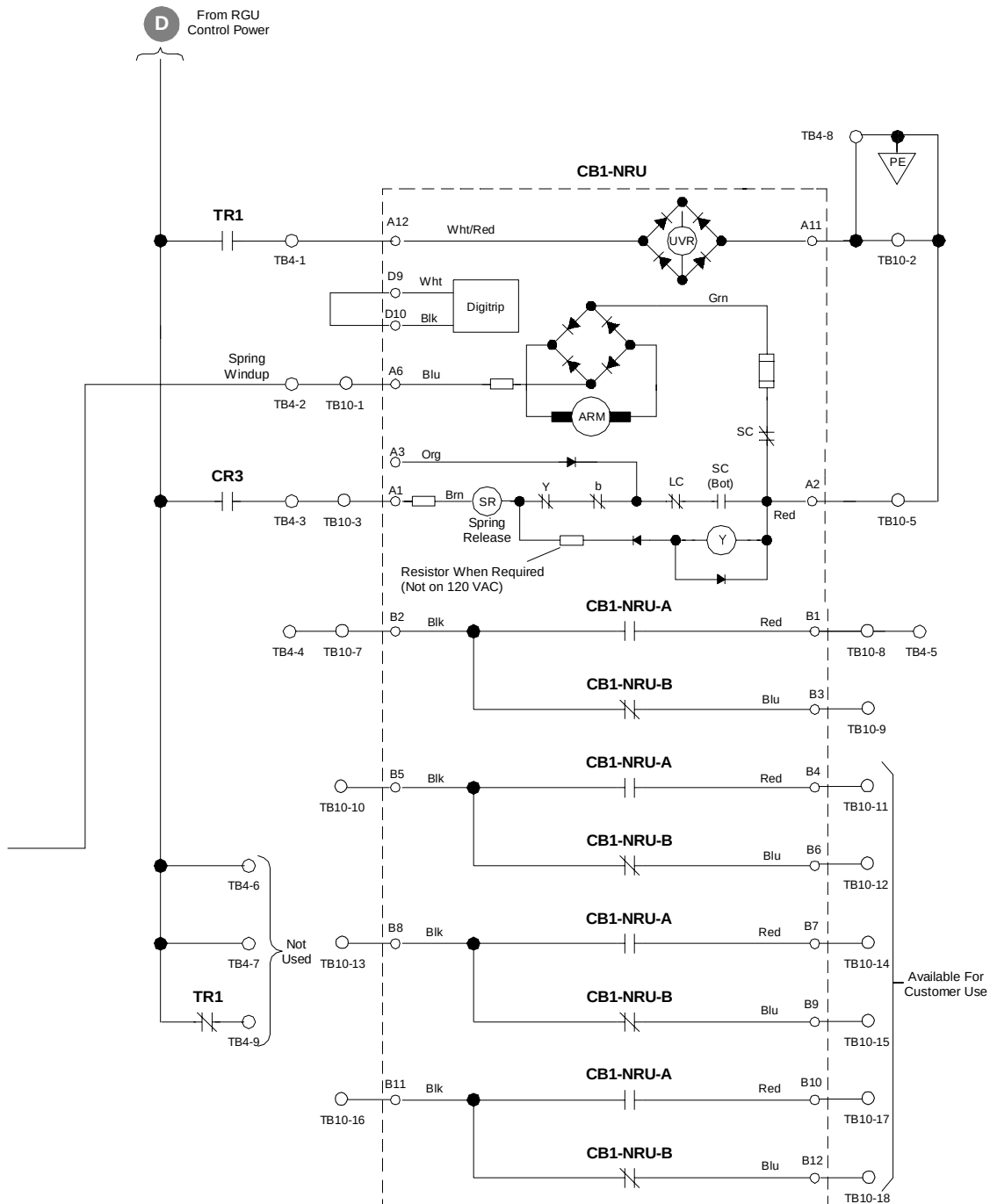
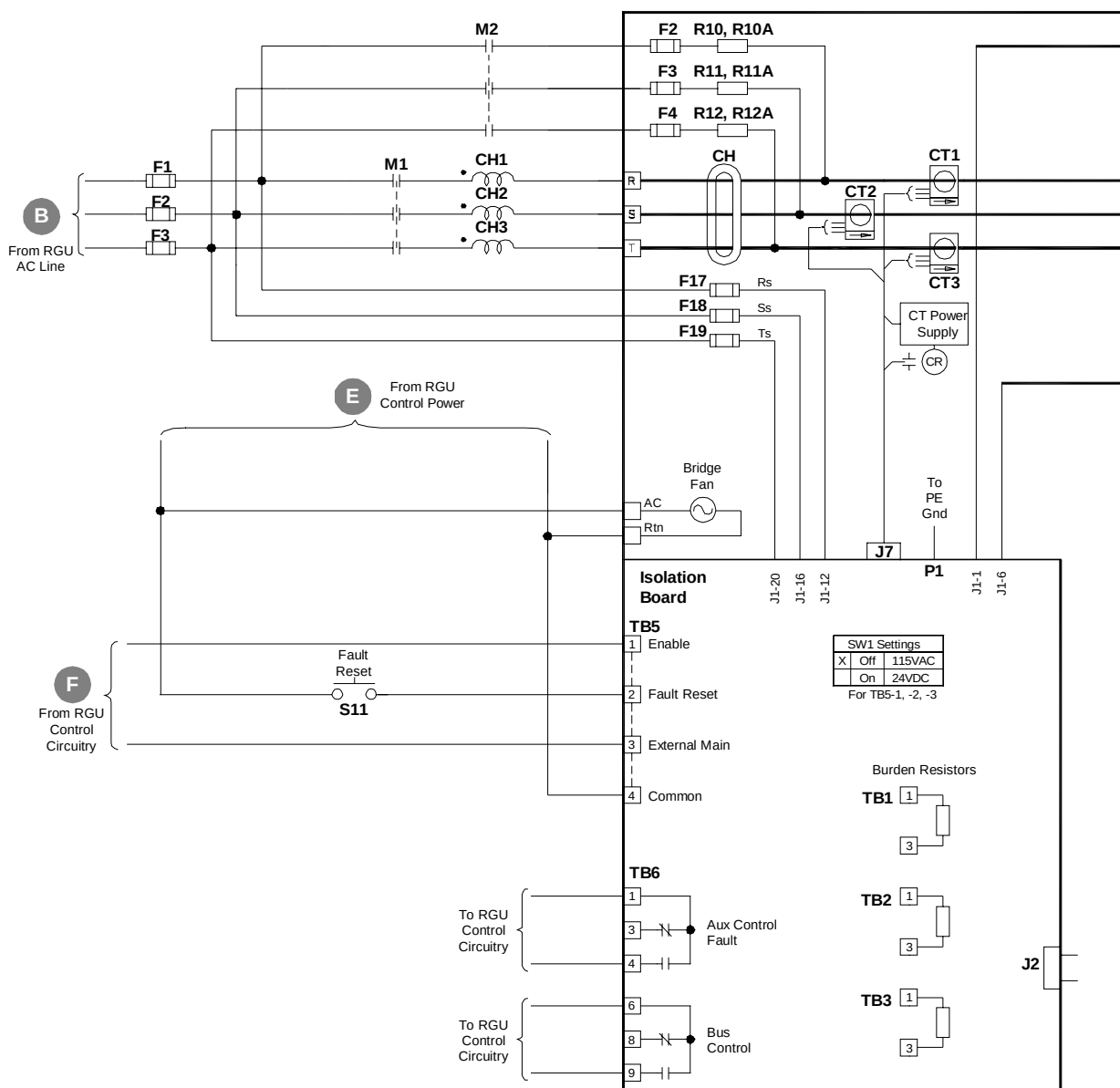


Figure 10.7
Schematics (cont.)



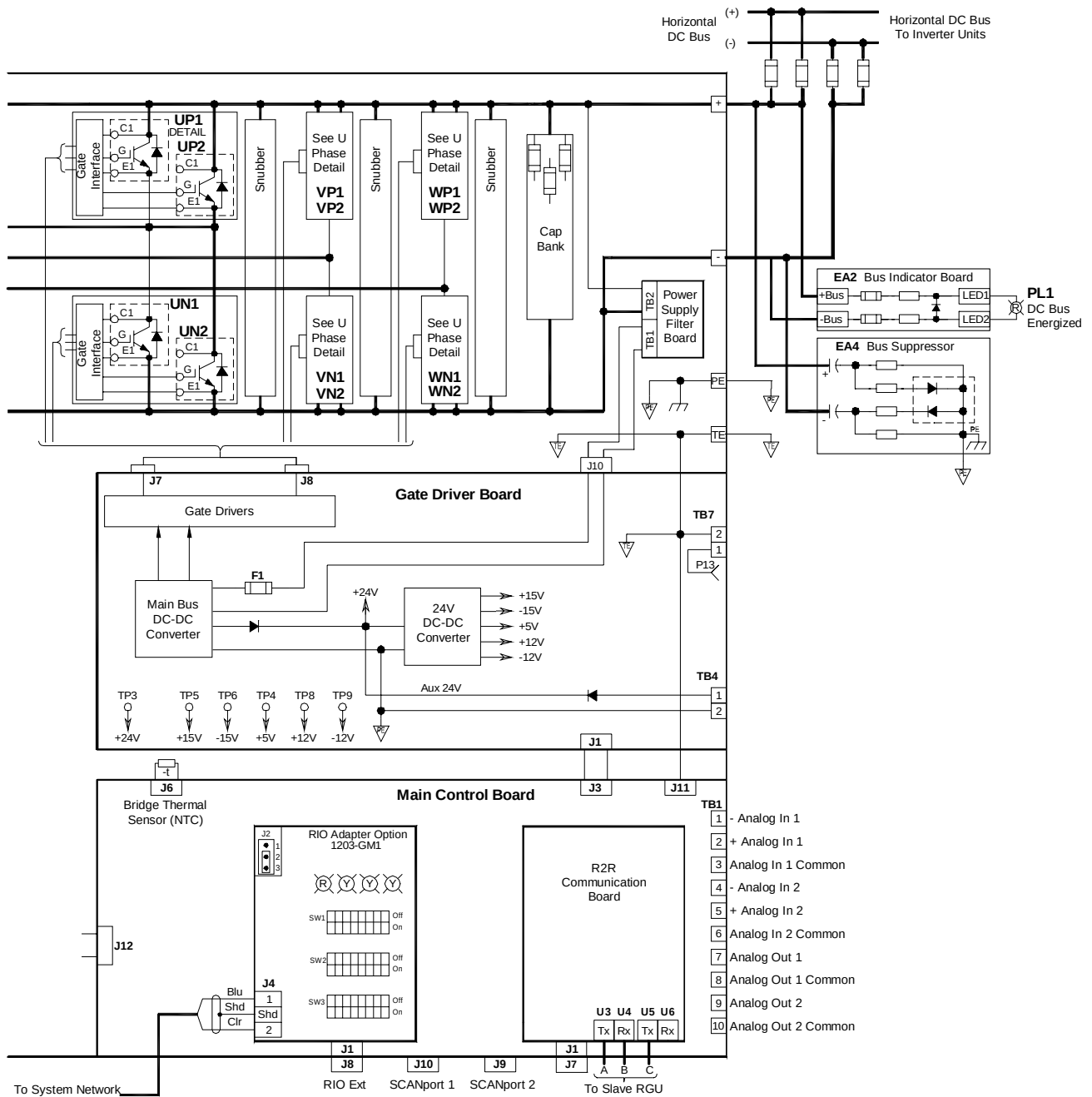
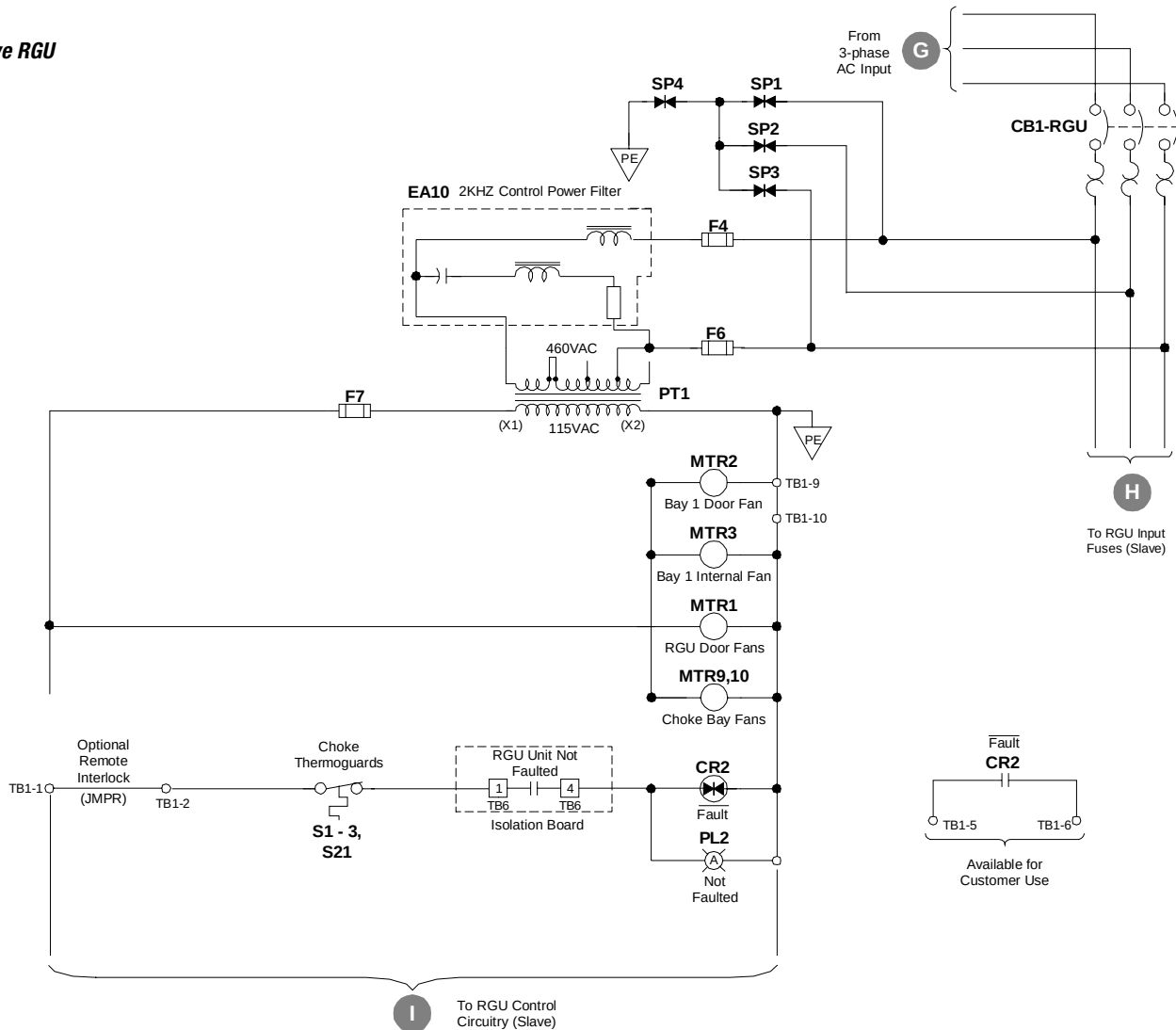


Figure 10.8
Schematics (cont.)

Slave RGU



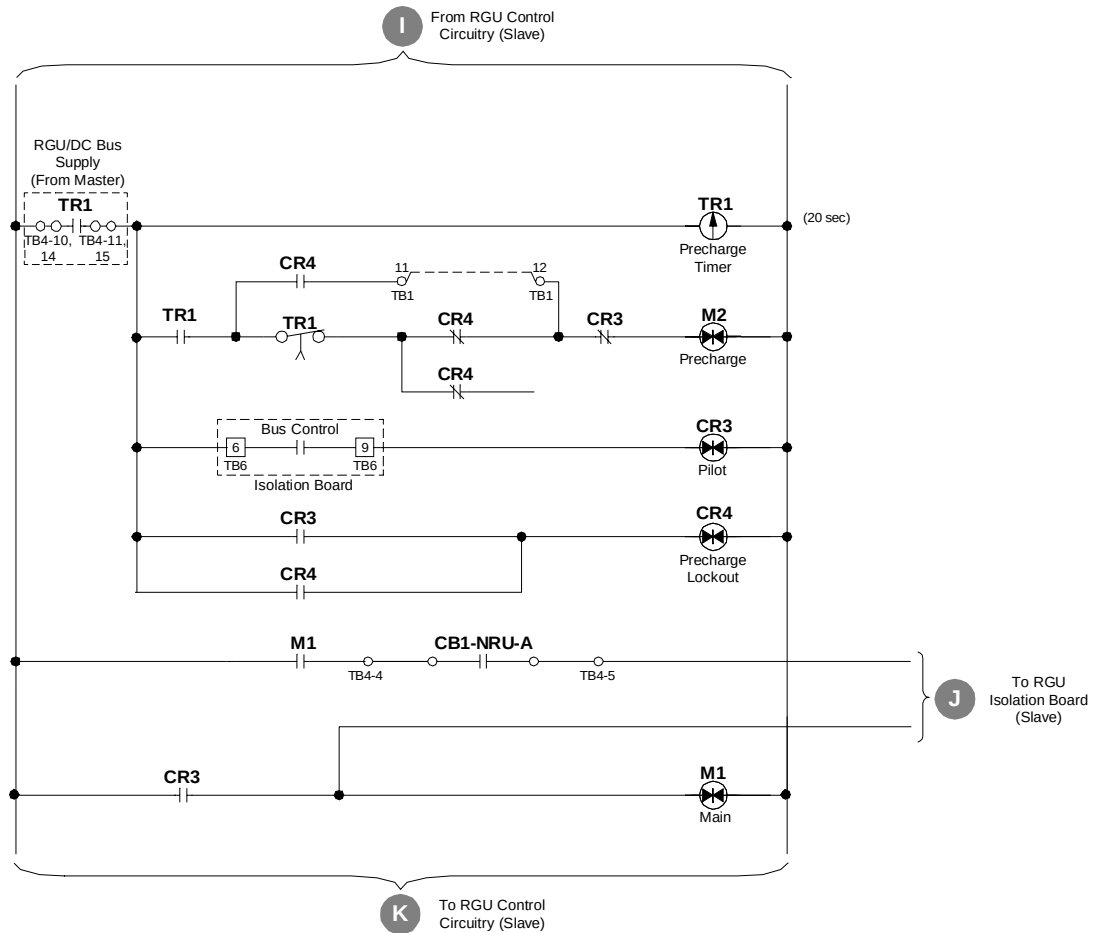
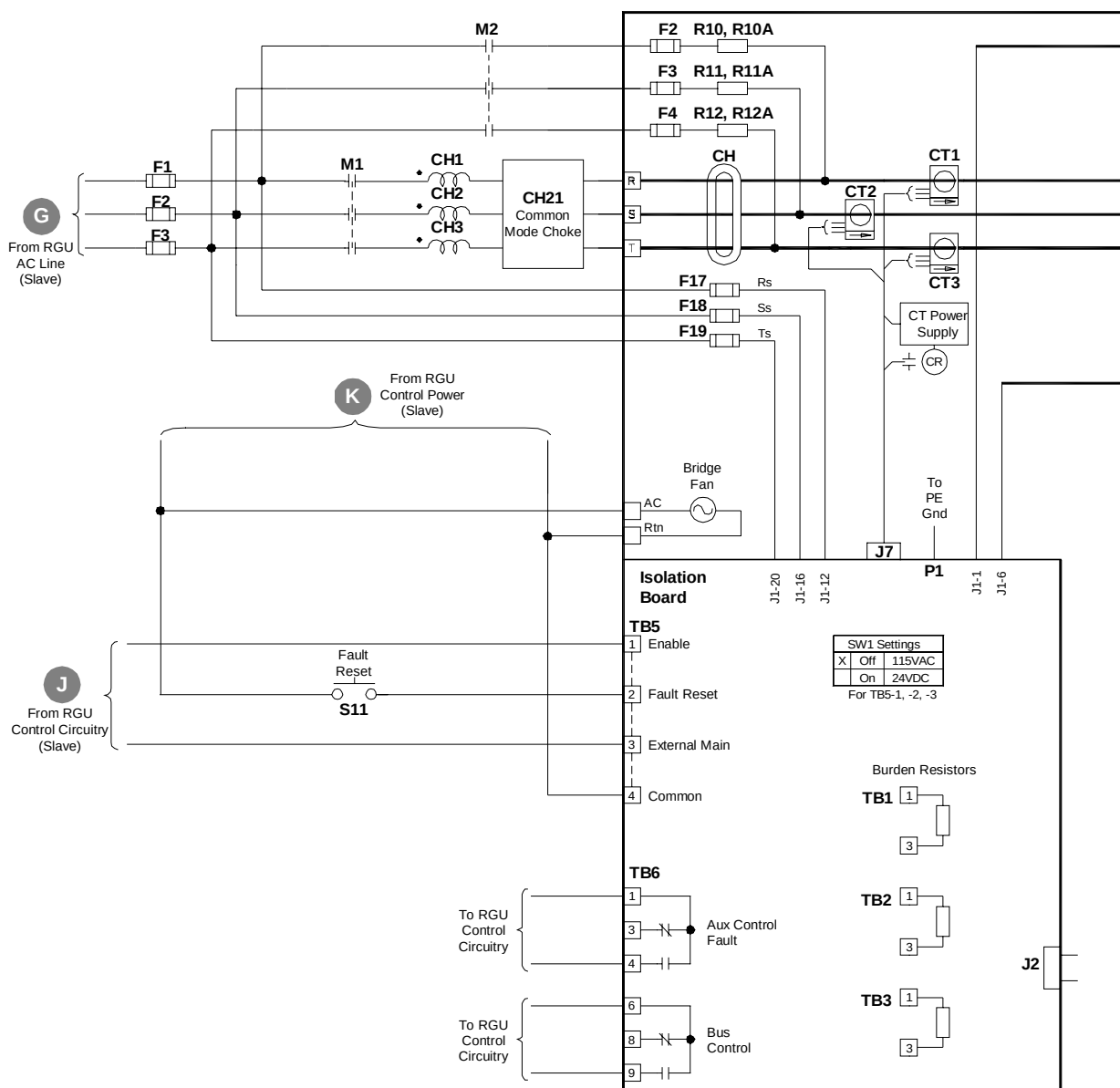
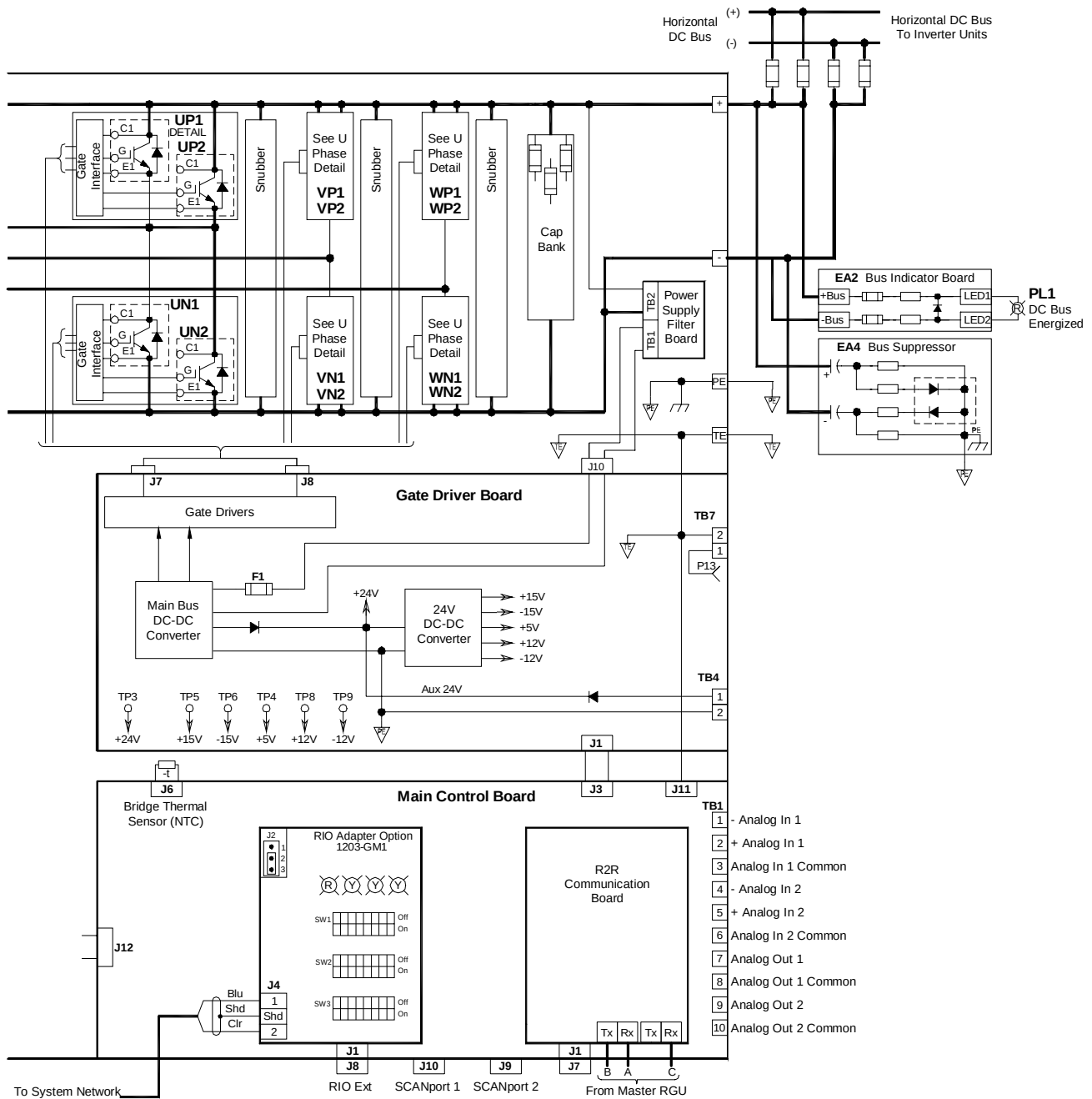


Figure 10.9
Schematics (cont.)





T6 and V6-Code Parallel Configurations

T6-Code Parallel Configuration

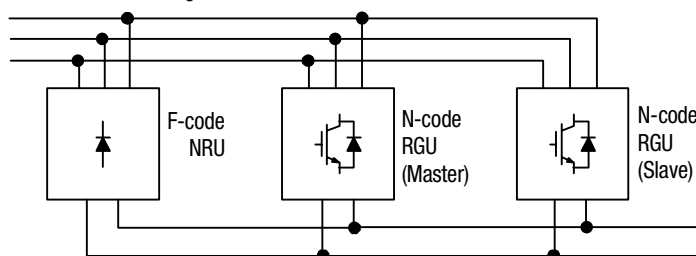
The T6-code parallel configuration is a common DC bus front-end unit consisting of an F-code NRU in parallel with two N-code RGUs.

Figure 11.1
T6-Code Parallel Configuration—Information

T5-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2699	1385
460	2700	1677
575	2683	2083

T6-code Parallel Configuration



V6-Code Parallel Configuration

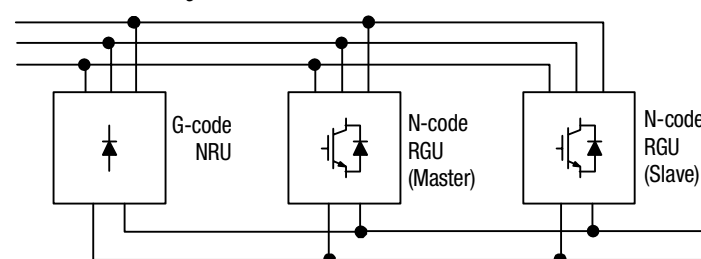
The V6-code parallel configuration is a common DC bus front-end unit consisting of a G-code NRU in parallel with two N-code RGUs.

Figure 11.2
V6-Code Parallel Configuration—Information

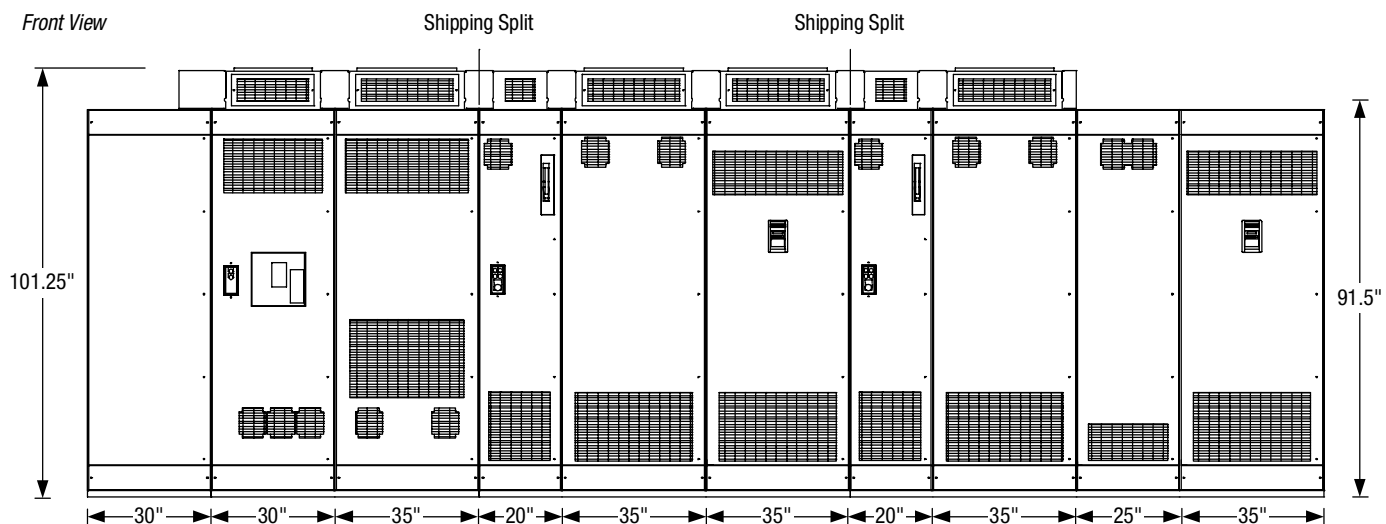
V6-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	3000	1539
460	3000	1863
575	3000	2329

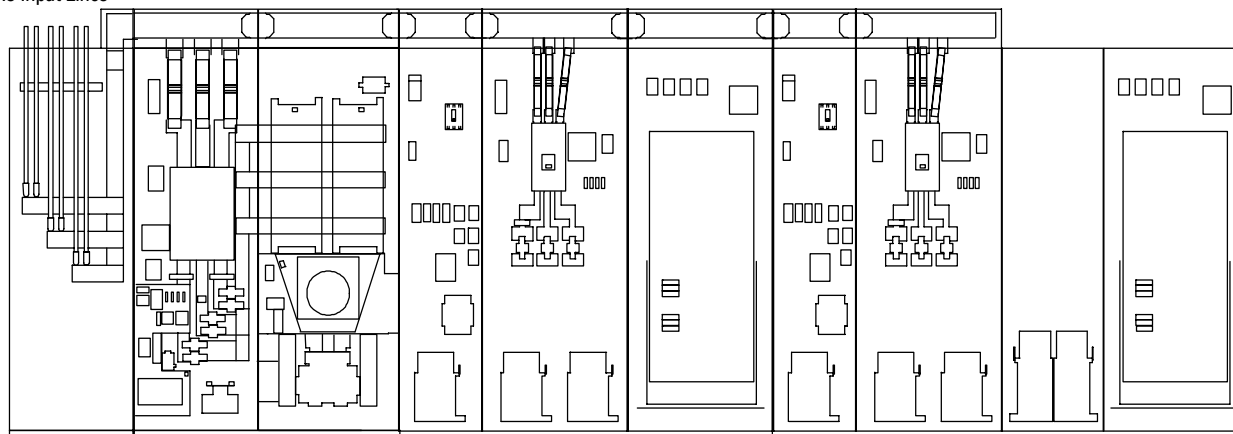
V6-code Parallel Configuration



Note: Information for the F-code NRU and G-code NRU can be found in publication 2364E-5.01. Information for the N-code RGU can be found in publication 2364F-5.01.

Component Layout**Figure 11.3
Enclosure Layout***Cutaway View*

Customer Supplied
AC Input Lines



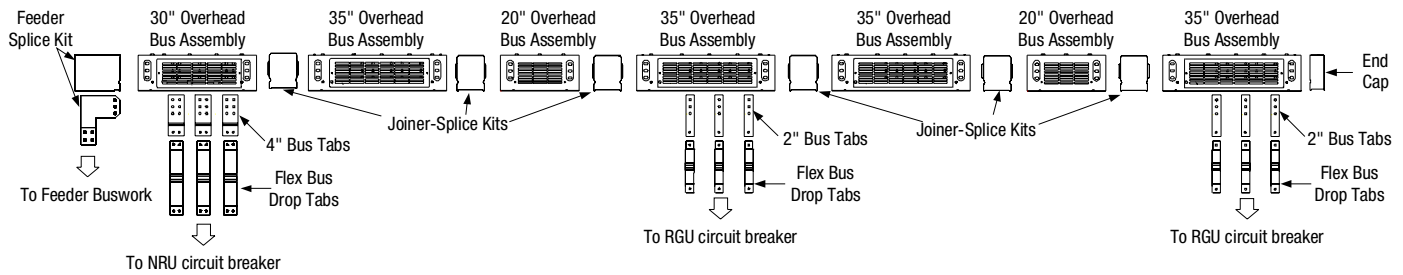
Feeder

F-code (2500A) or G-code (3000A)
NRU

N-code RGU (Master)

N-code RGU (Slave)

Figure 11.4
Overhead Bus Assembly



New and Revised NRU and RGU Components in the T6 and V6 Configurations

NRU	CB1	(T1 config) 2500A, SPB-frame with motor operator (V1 config) 3000A, SPB-frame with motor operator	
	EA10	Control power filter, 2kHz	
	F4, F6	Primary fuse for 5kVA control transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
	TB10	Control terminal block, 30A, 600V	

RGU (master)	CR4	Precharge Lockout Relay (2NO/2NC)
	EA11	R2R Communication Board
	F4, F6	Primary fuse for 5kVA transformer
		25A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M
	F25	Fuse, NRU CB1 motor operator, 10A, KLDR
	PT1	Control power transformer, 5kVA
	TR1	Timer relay (3NO/1NC)
	TB4	Control Terminal block, 30A, 600V

RGU (slave)	CH21	Common Mode Choke, 900A, 4mH
	CR4	Precharge Lockout Relay (2NO/2NC)
	EA11	R2R Communication Board
	F4, F6	Primary fuse for 5kVA transformer
		25A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M
	PT1	Control power transformer, 5kVA
	TR1	Timer relay (3NO/1NC)
	TB4	Control Terminal block, 30A, 600V
		Fiber optic cable, 26', HP HFBR connector

Overhead bus assembly

Figure 11.5 Schematics

The diagram illustrates the 115VAC Control Bus To Inverter Units. It shows the power distribution from a 460VAC source through a transformer (PT1) to a 115VAC bus. The bus is protected by fuses (F1-F8) and switches (S1-S3). It also features a fault detection system (B) and a ground fault detector (CR2). The diagram is divided into three main sections: Power Distribution, Safety and Protection, and Fault Detection.

Power Distribution: The 460VAC source is connected to the primary of transformer PT1. The secondary of PT1 provides 115VAC to the control bus. The bus is protected by fuses F1, F2, F3, F4, F5, F6, F7, and F8. The bus is also connected to a ground fault detector (CR2) and a fault detection system (B).

Safety and Protection: The control bus is protected by switches S1, S2, and S3. S1 is a CB Bay Overtemp switch, S2 is a Heatsink Overtemp Left switch, and S3 is a Heatsink Overtemp Right switch. The bus is also connected to a fault detection system (B) and a ground fault detector (CR2).

Fault Detection: The fault detection system (B) is connected to the control bus and the ground fault detector (CR2). CR2 is a fault detection relay that provides a signal to the inverter units. The diagram also shows a ground fault detector (CR2) and a fault detection system (B).

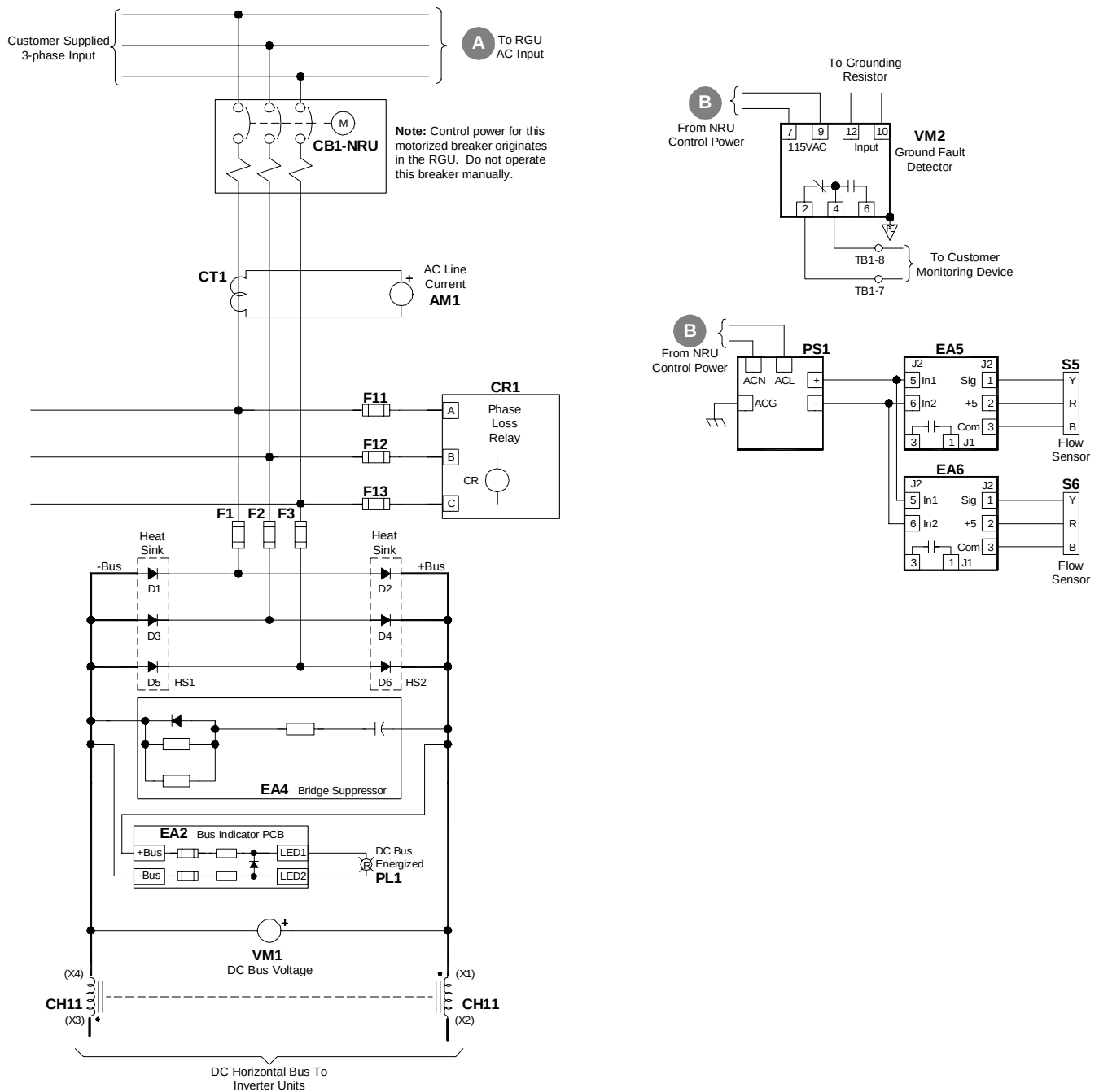
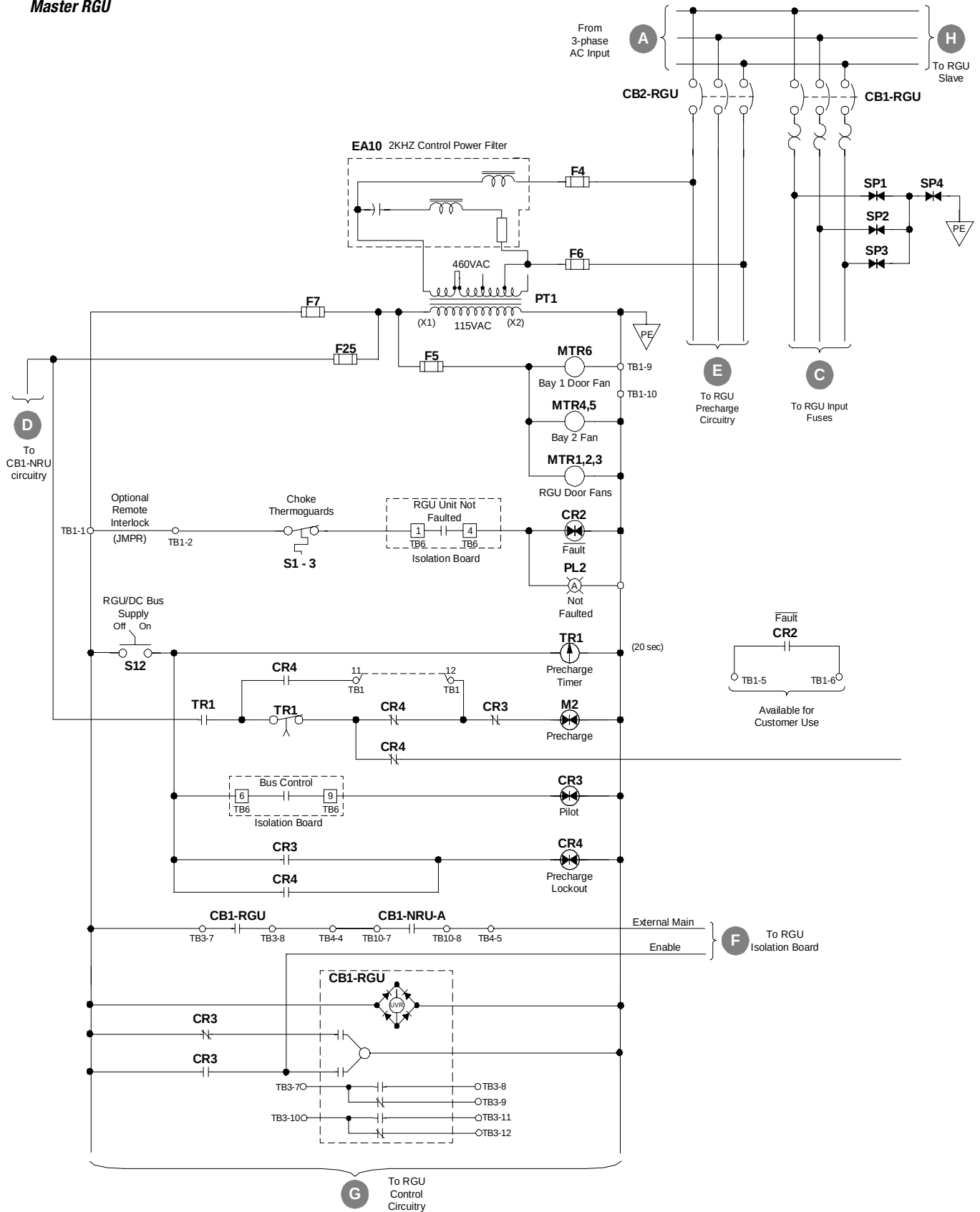


Figure 11.6
Schematics (cont.)

Master RGU



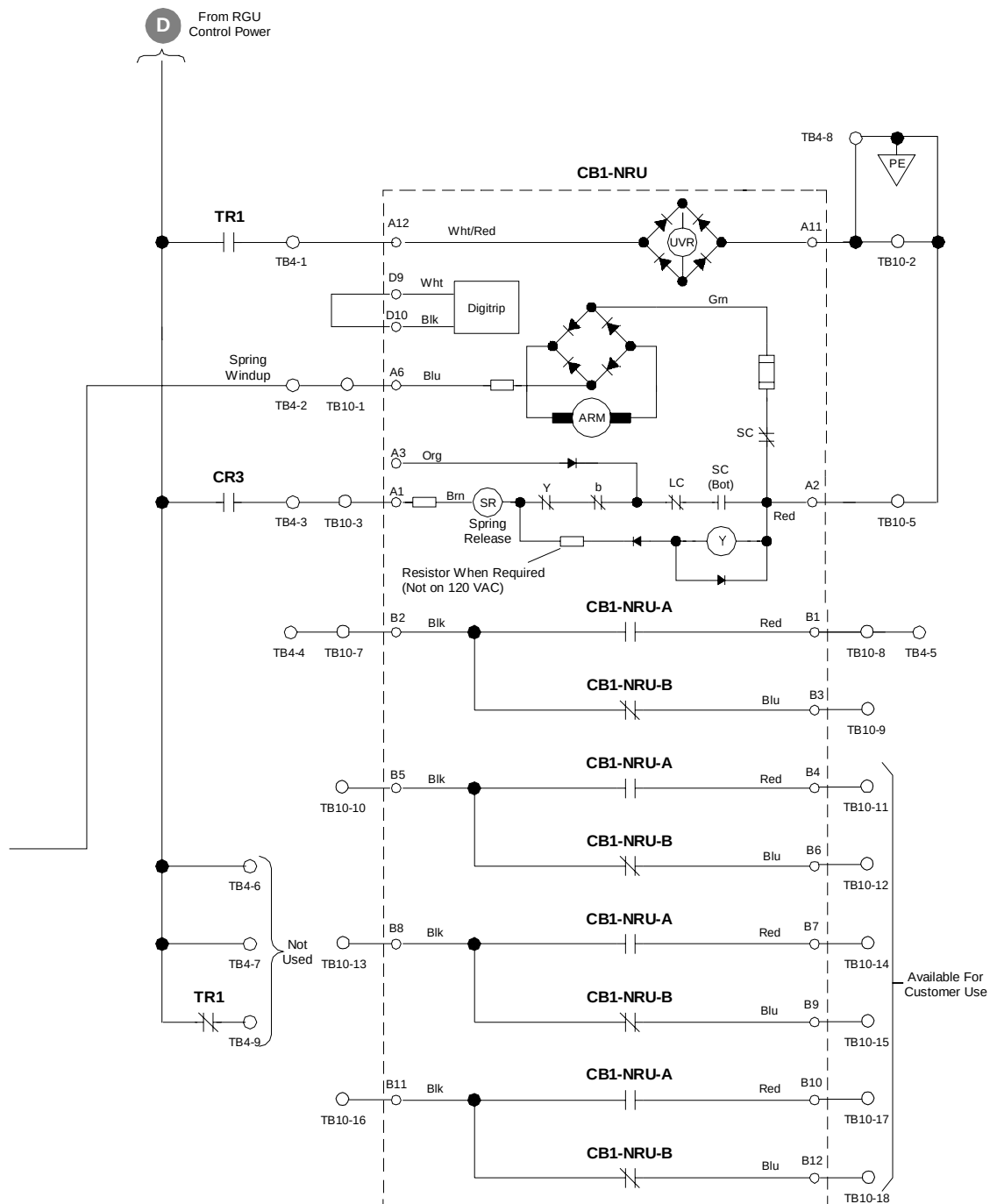
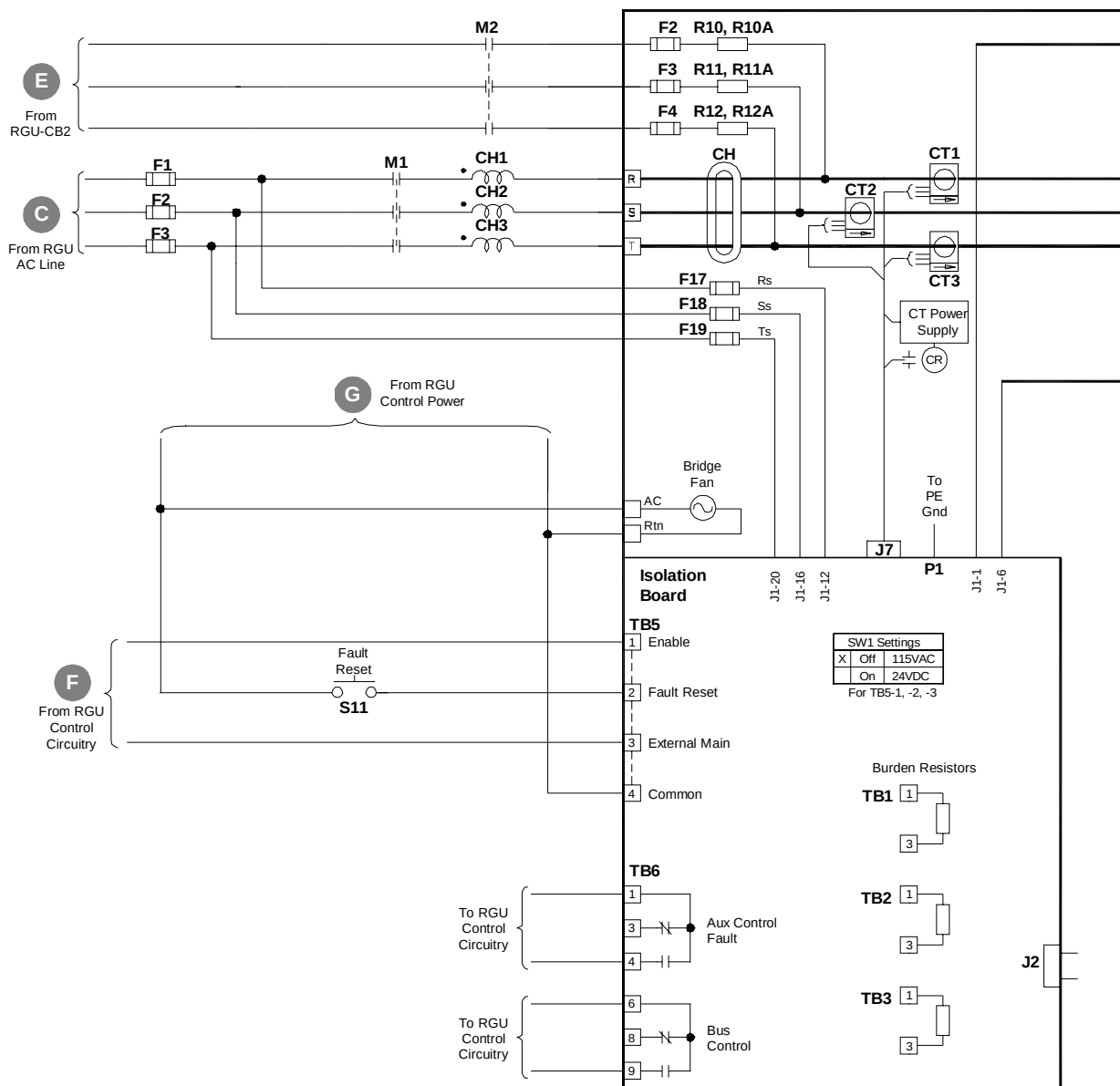


Figure 11.7
Schematics (cont.)



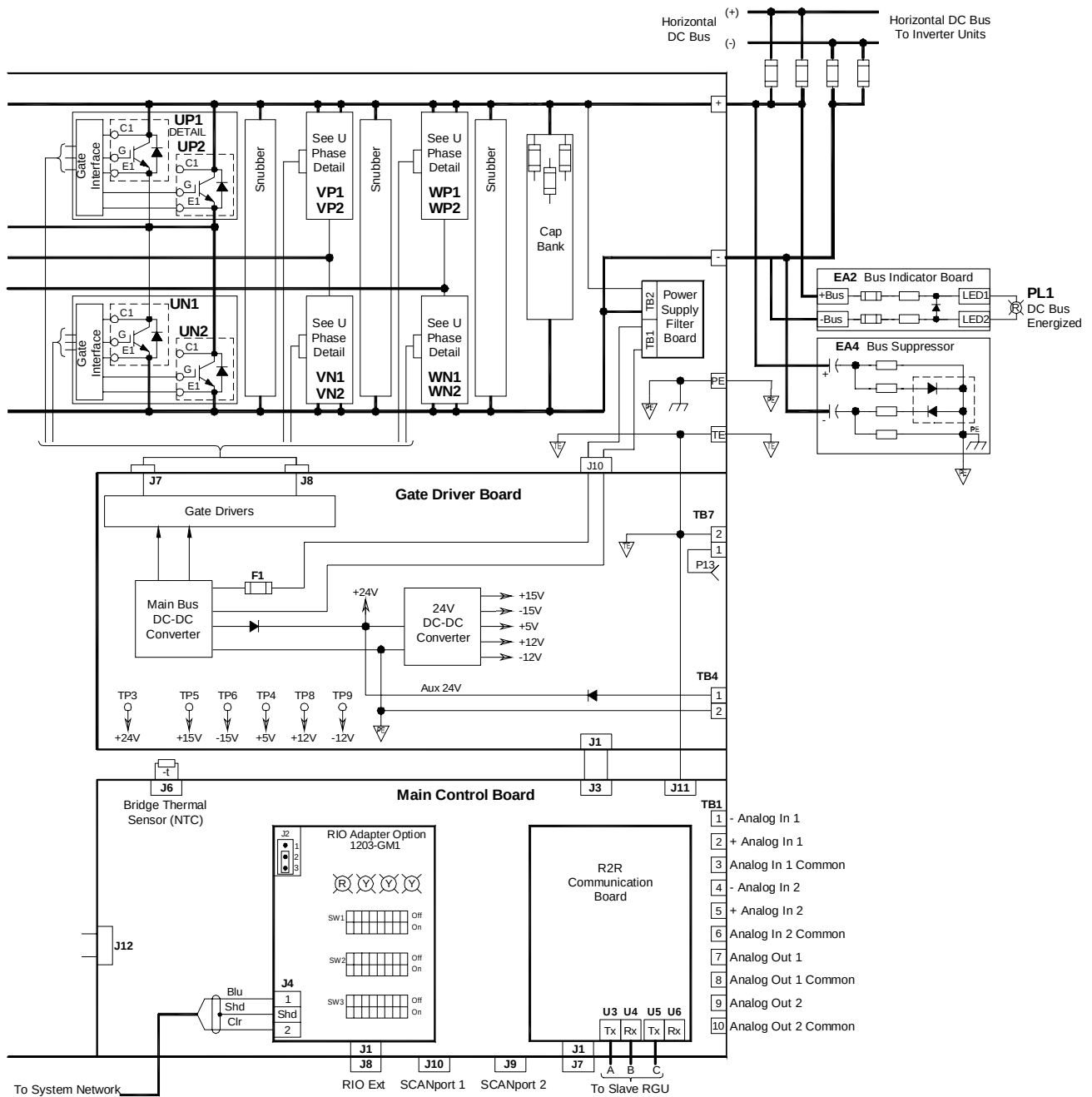
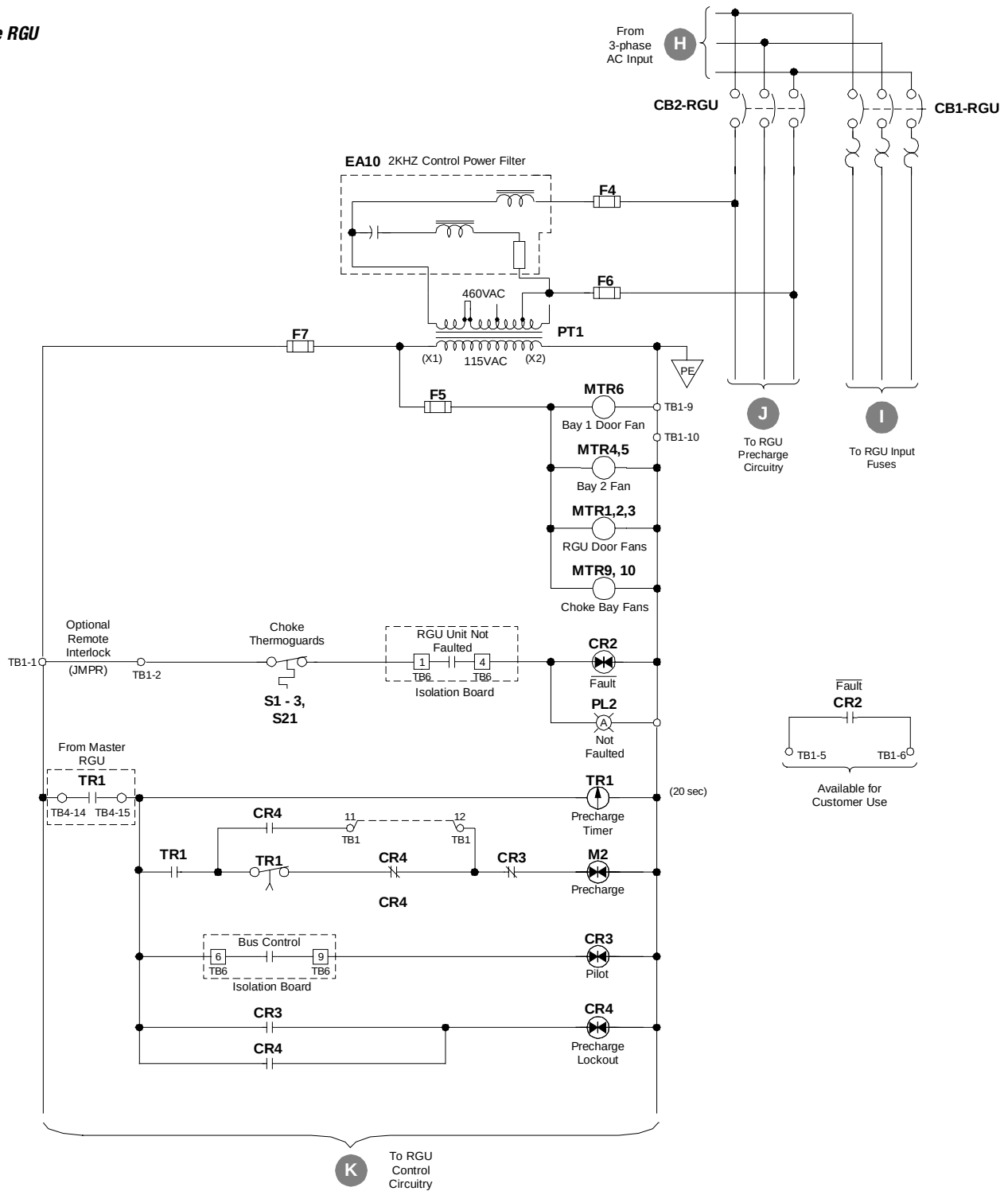


Figure 11.8
Schematics (cont.)

Slave RGU



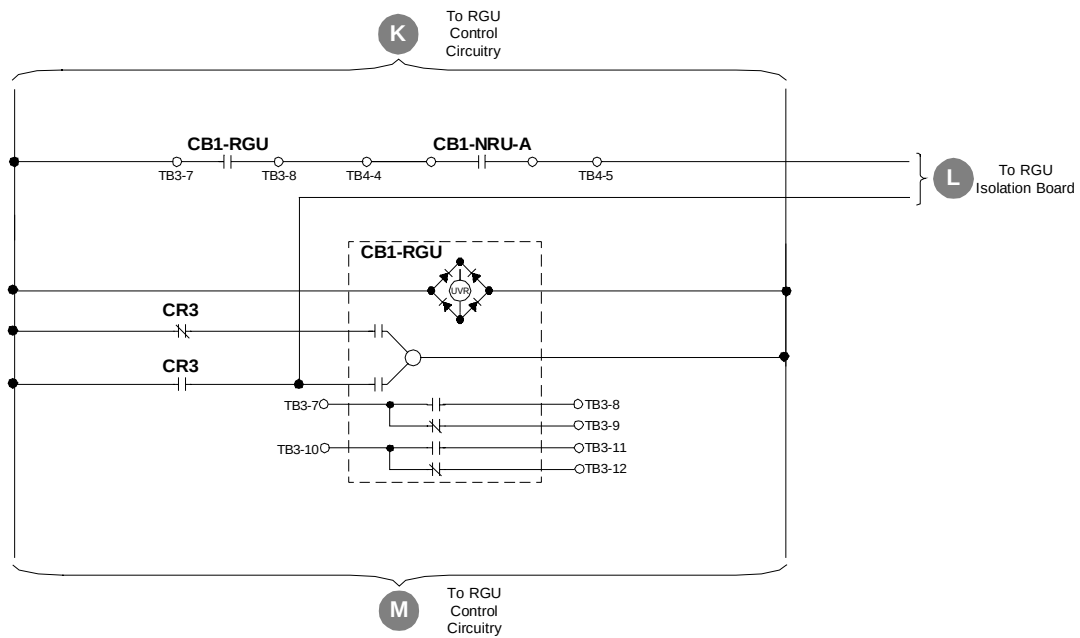
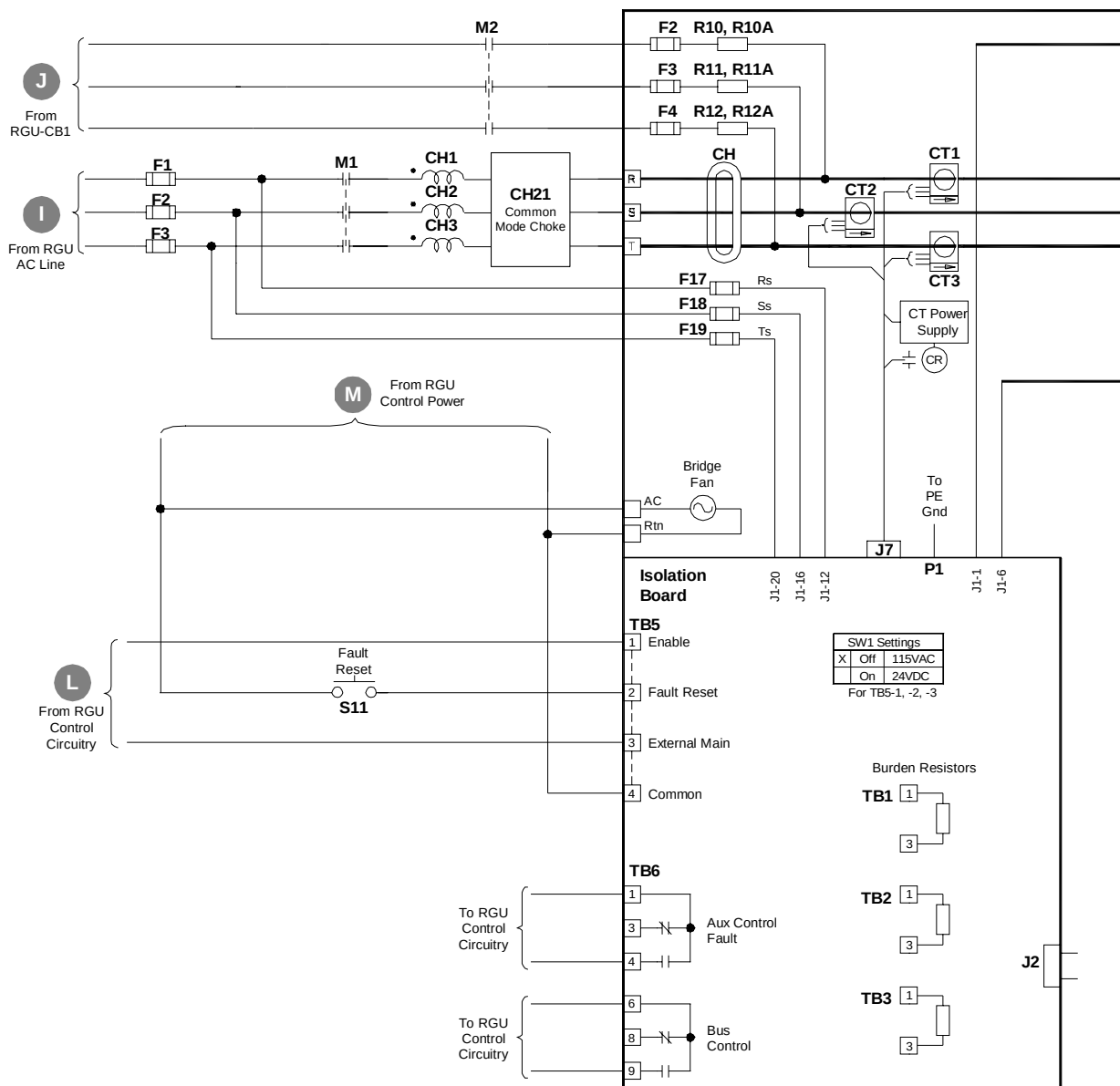
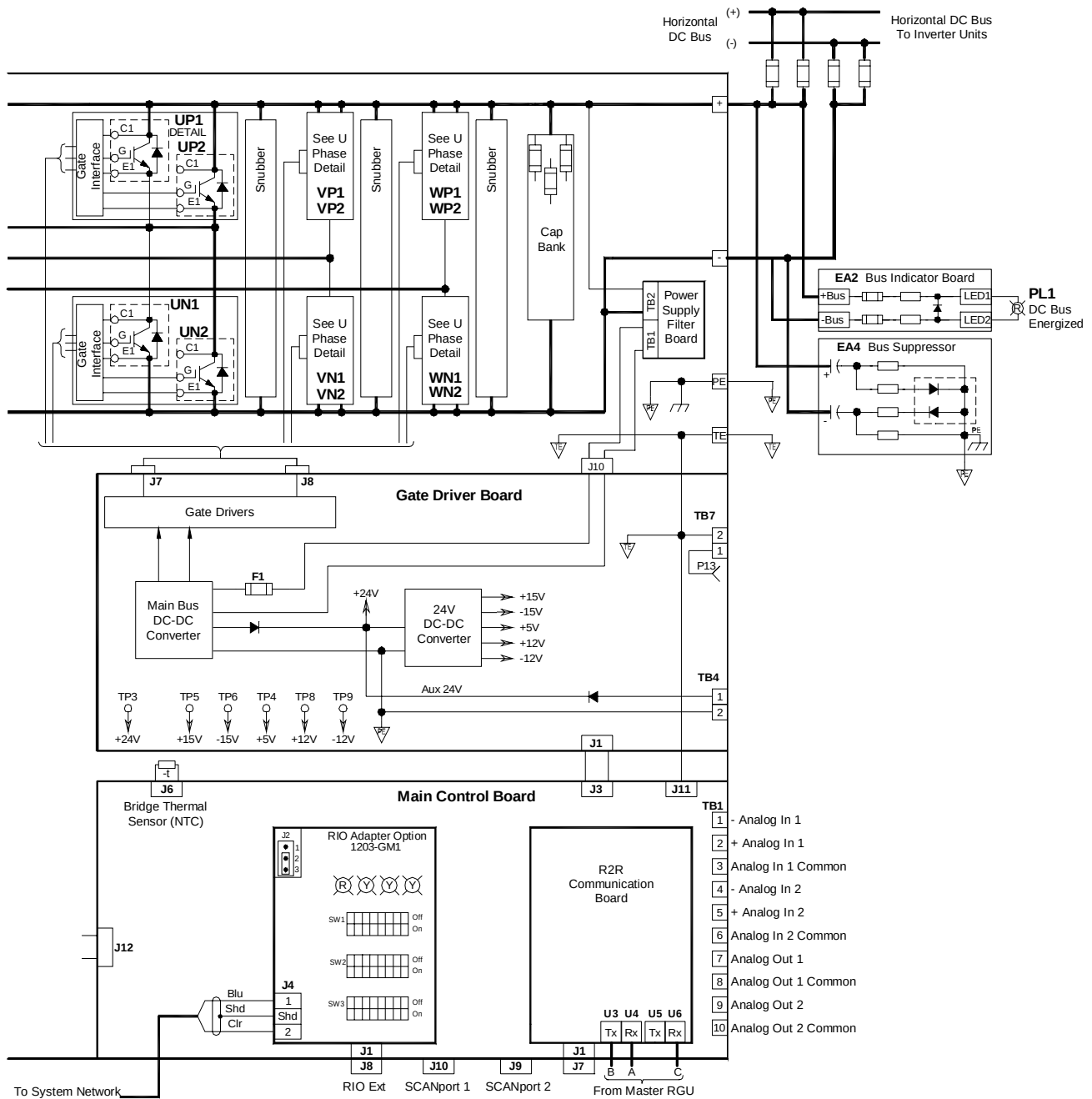


Figure 11.9
Schematics (cont.)

Slave RGU





W1-Code Parallel Configuration

W1-Code Parallel Configuration

The W1-code parallel configuration is a common DC bus front-end unit consisting of two M-code RGUs.

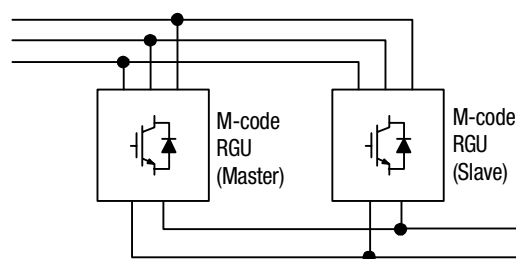
Figure 12.1

W1-Code Parallel Configuration—Information

W1-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	1492	865
460	1498	1049
575	1372	1163

W1-code Parallel Configuration

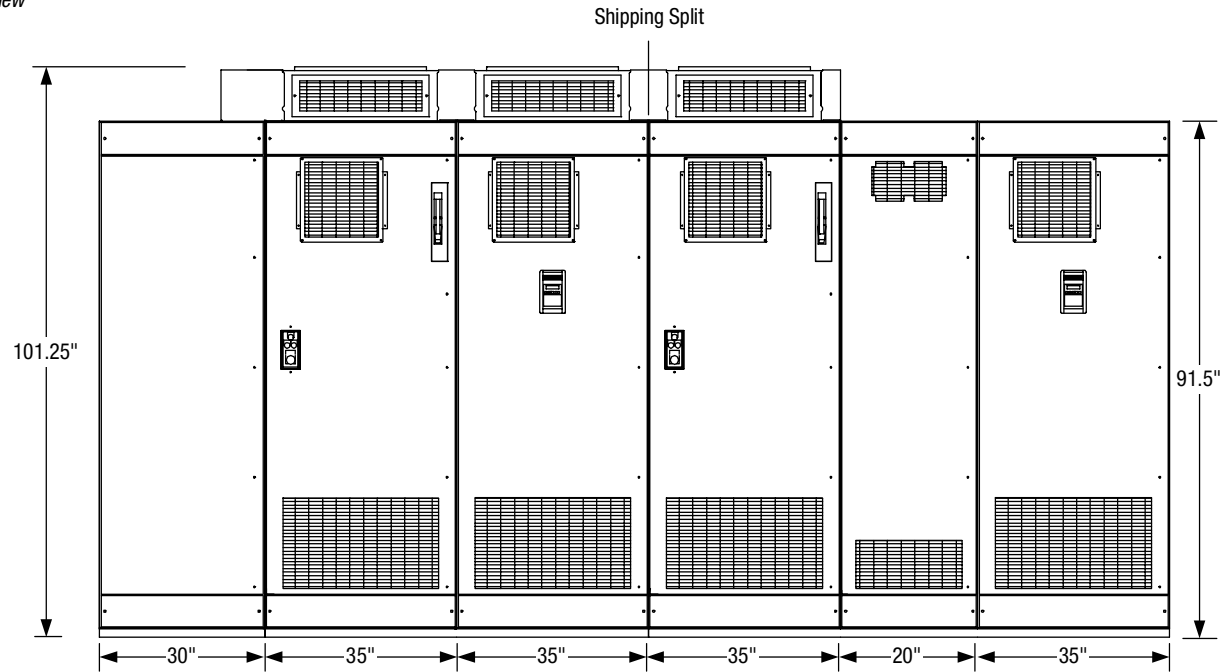


Note: Information for the M-code RGU can be found in publication 2364F-5.01.

Component Layout

Figure 12.2
Enclosure Layout

Front View



Cutaway View

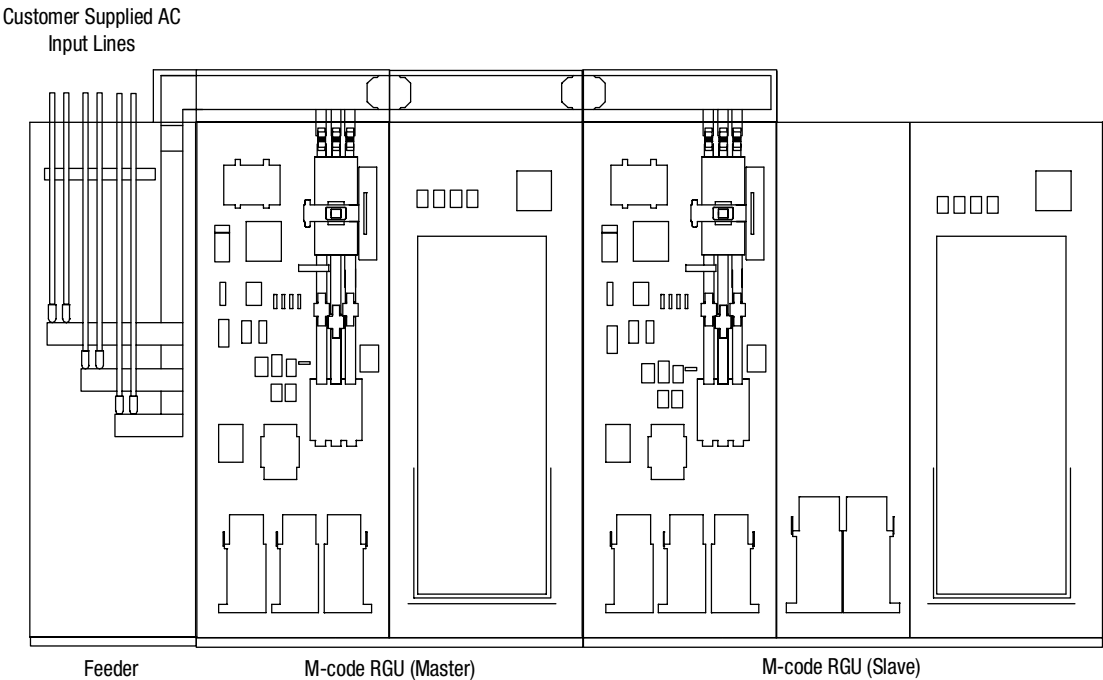
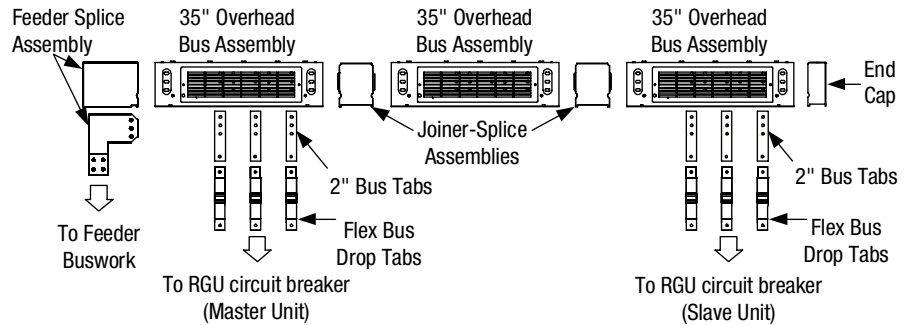


Figure 12.3
Overhead Bus Assembly

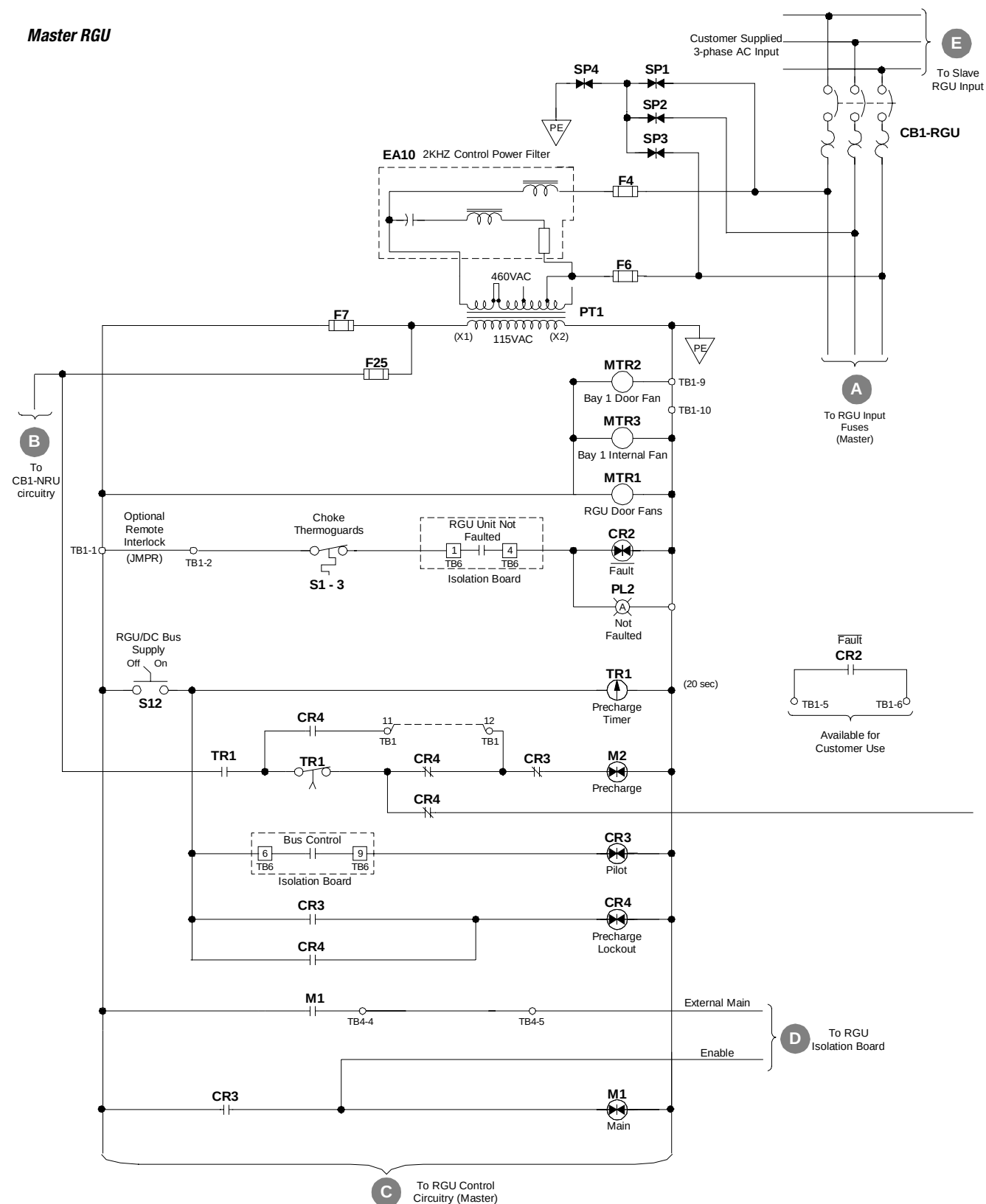


New and Revised RGU Components in the W1 Configuration

RGU (master)	CR3	Pilot relay (2NO/2NC) with aux contact (1NO/1NC)	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	F25	Fuse, CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
RGU (slave)	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
	CH21	Common Mode Choke, 600A, 4mH	
	CR3	Pilot relay (2NO/2NC) with aux contact (1NO/1NC)	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer	
		25A, KLDR (for 380V AC input)	
		20A, KLDR (for 460V AC input)	
		17.5A, KLDR (for 575V AC input)	
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
		Fiber optic cable, 26', HP HFBR connector	

Overhead bus assembly

Schematics

Figure 12.4
Schematics

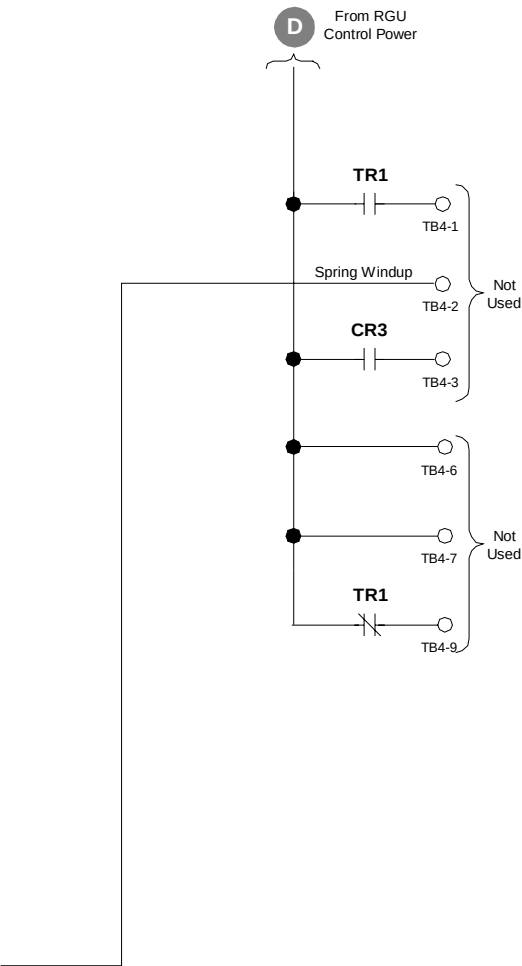
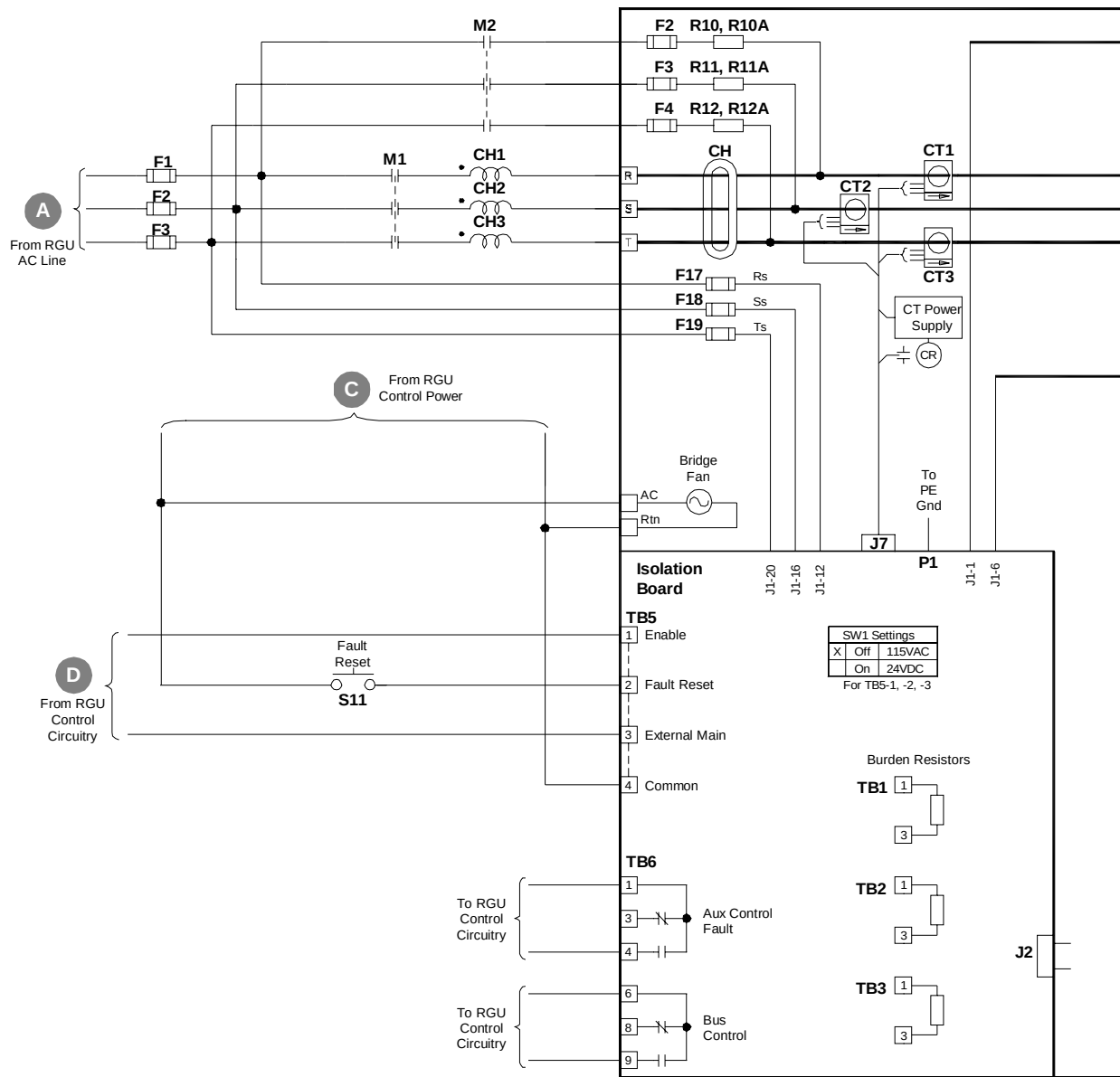


Figure 12.5
Schematics (cont.)



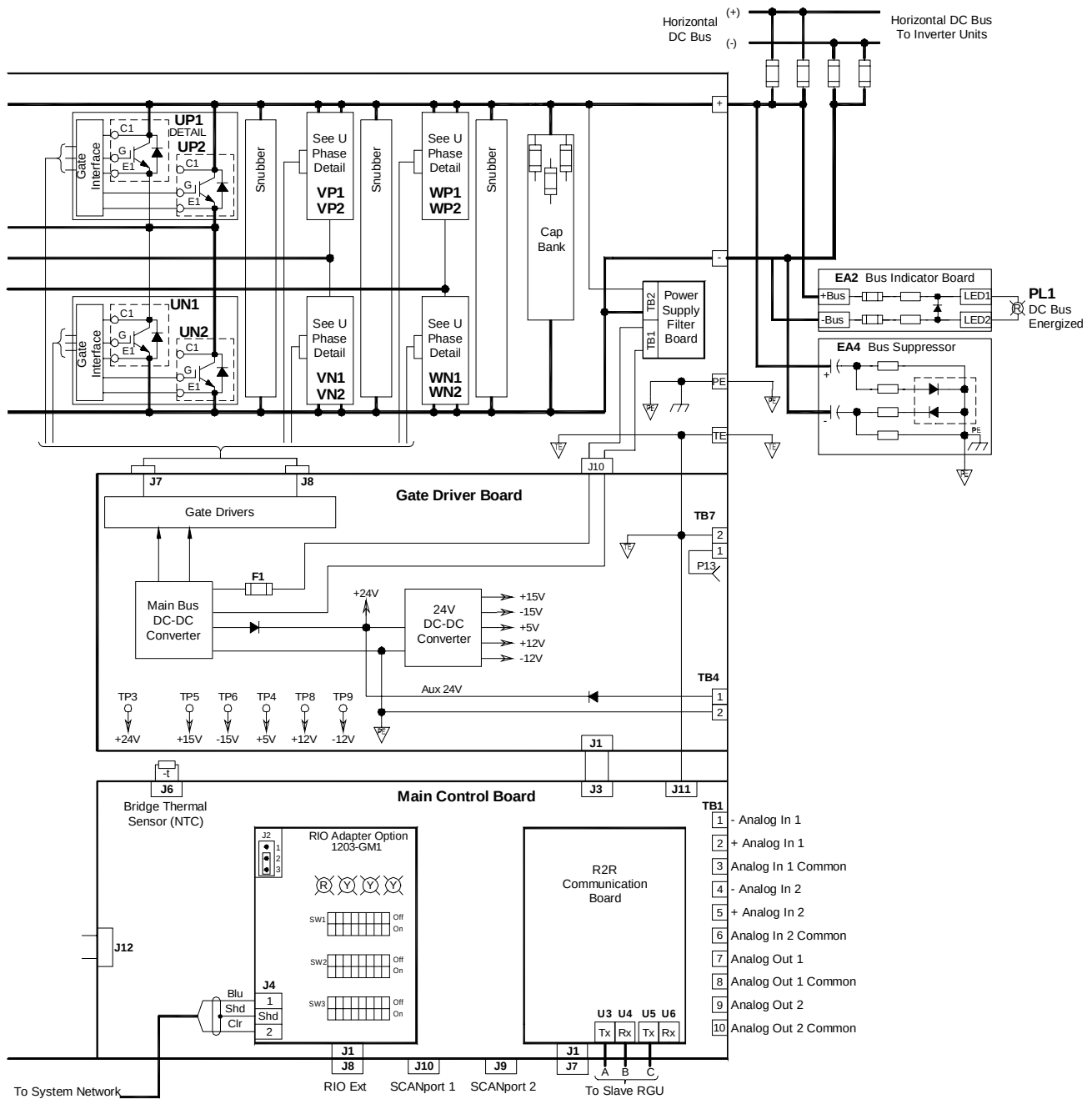
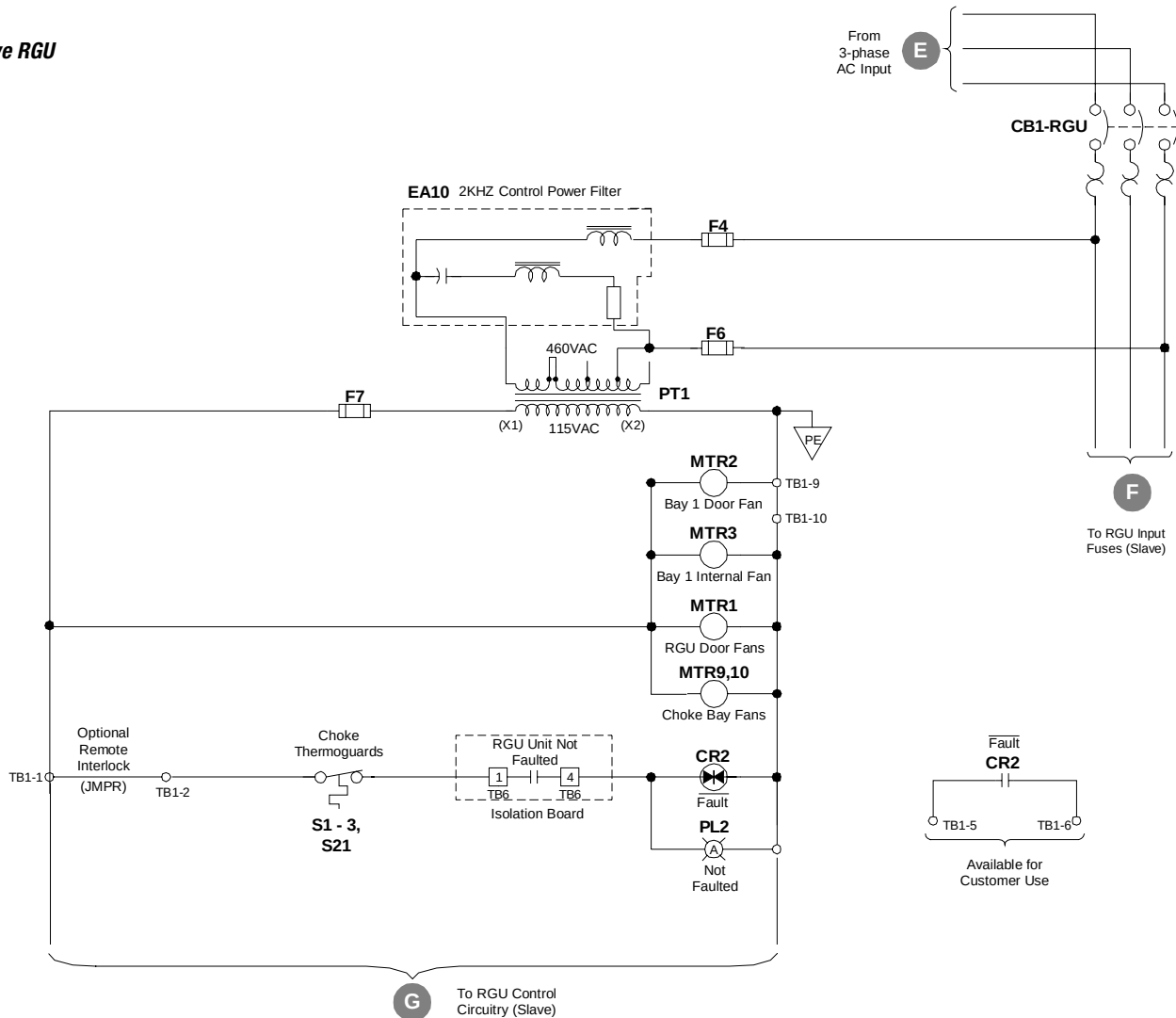


Figure 12.6
Schematics (cont.)

Slave RGU



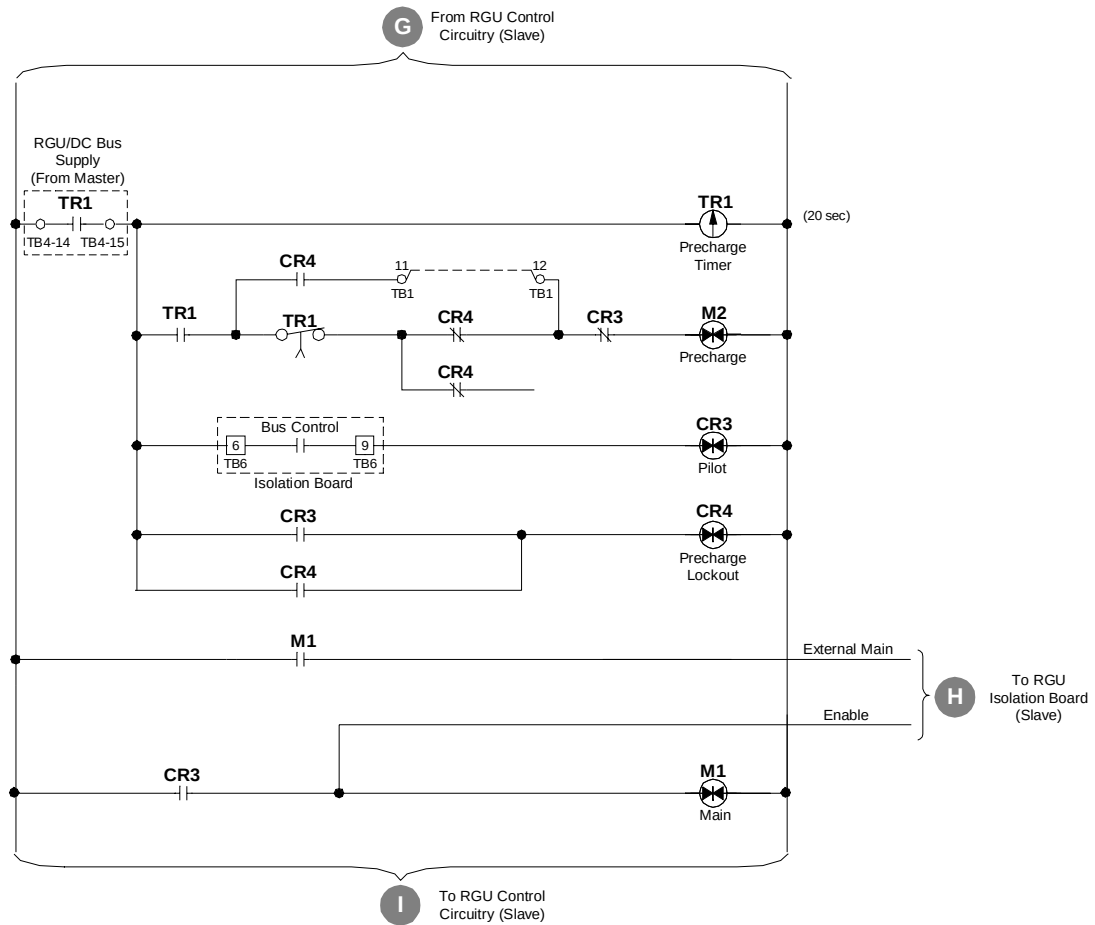
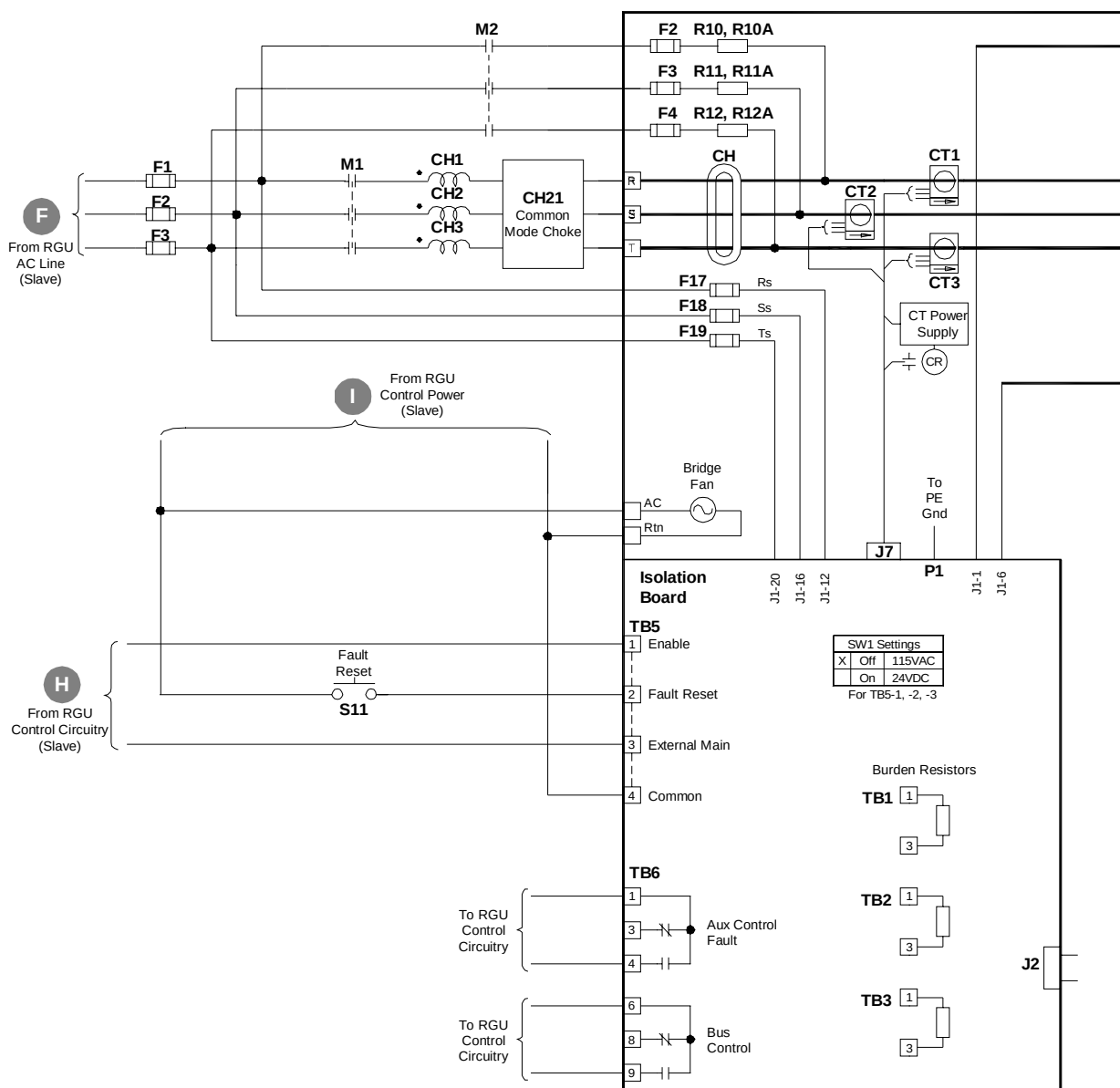
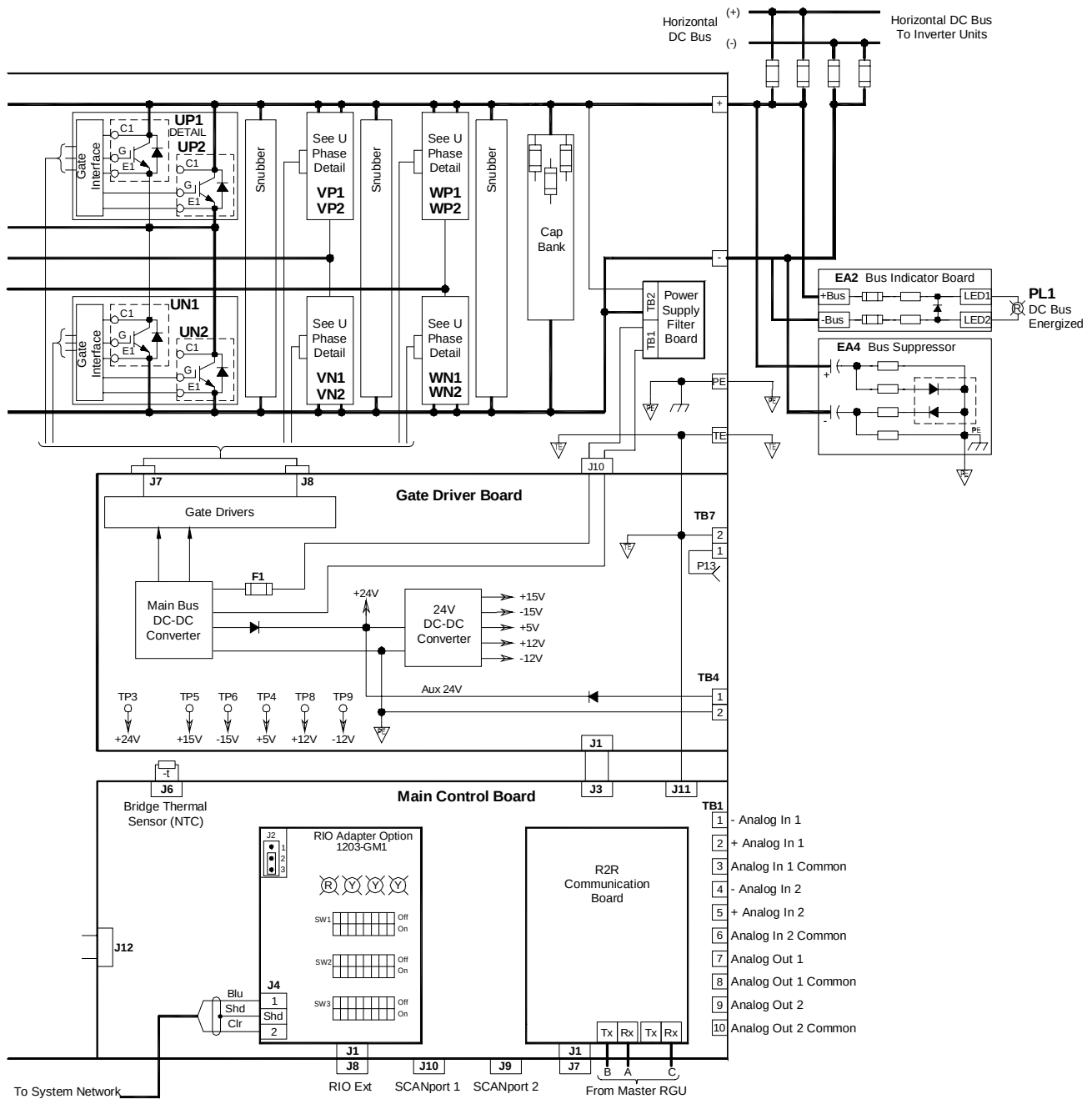


Figure 12.7
Schematics (cont.)





W2-Code Parallel Configurations

W2-Code Parallel Configuration

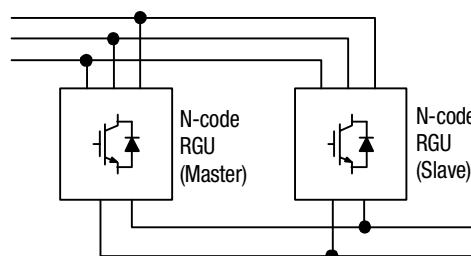
The W2-code parallel configuration is a common DC bus front-end unit consisting of two N-code RGUs.

Figure 13.1
W2-Code Parallel Configuration—Information

W2-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	1994	1157
460	2000	1400
575	1828	1550

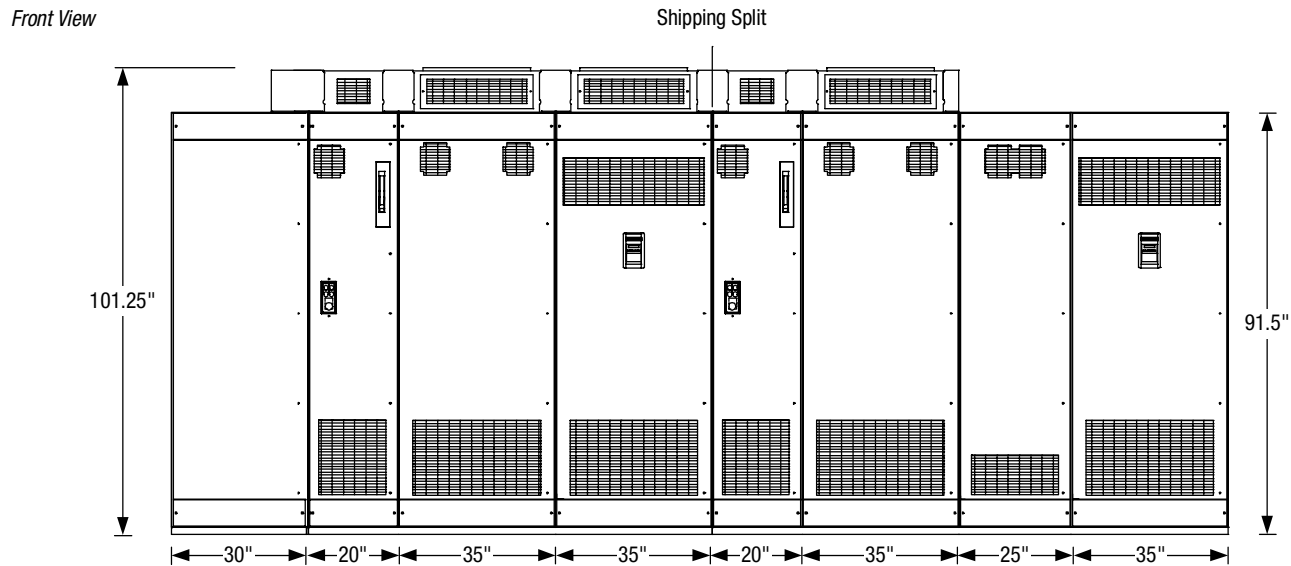
W2-code Parallel Configuration



Note: Information for the N-code RGU can be found in publication 2364F-5.01.

Component Layout

Figure 13.2
Enclosure Layout



Cutaway View

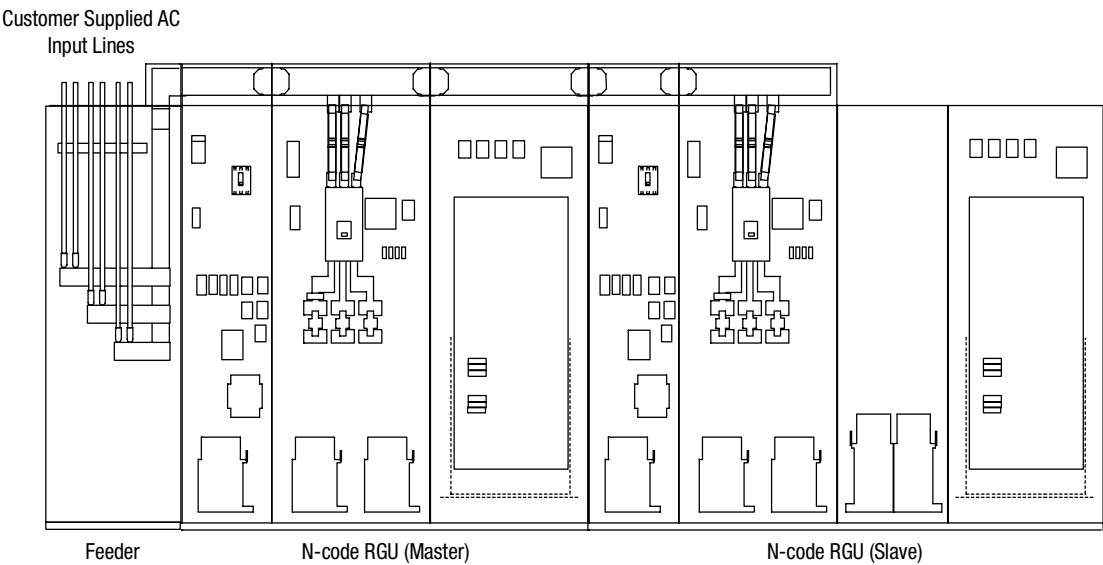
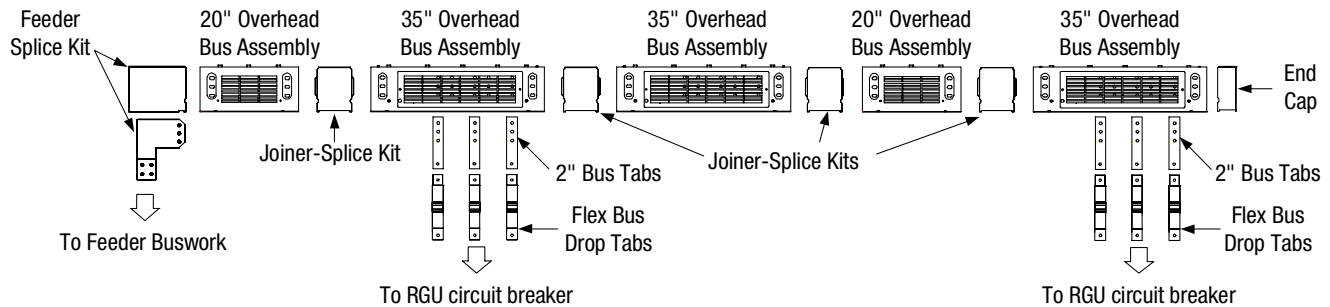


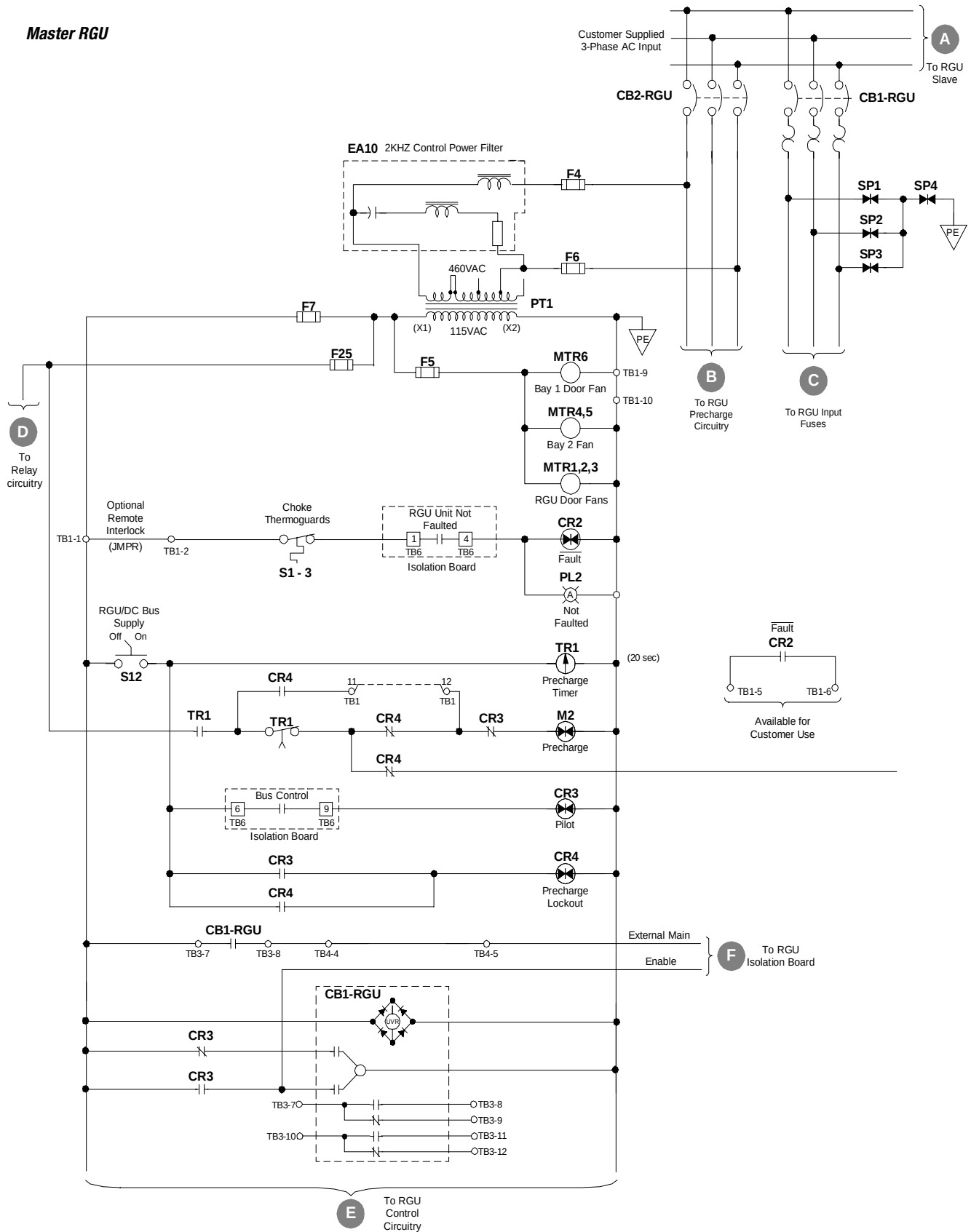
Figure 13.3
Overhead Bus Assembly



New and Revised RGU Components in the W2 Configuration

RGU (master)	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	F25	Fuse, CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
	TR1	Timer relay (3NO/1NC)	
RGU (slave)	TB4	Control Terminal block, 30A, 600V	
	CH21	Common Mode Choke, 900A, 4mH	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer	
		25A, KLDR (for 380V AC input)	
		20A, KLDR (for 460V AC input)	
		17.5A, KLDR (for 575V AC input)	
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
		Fiber optic cable, 26', HP HFBR connector	
Overhead bus assembly			

Schematics

Figure 13.4
Schematics**Master RGU**

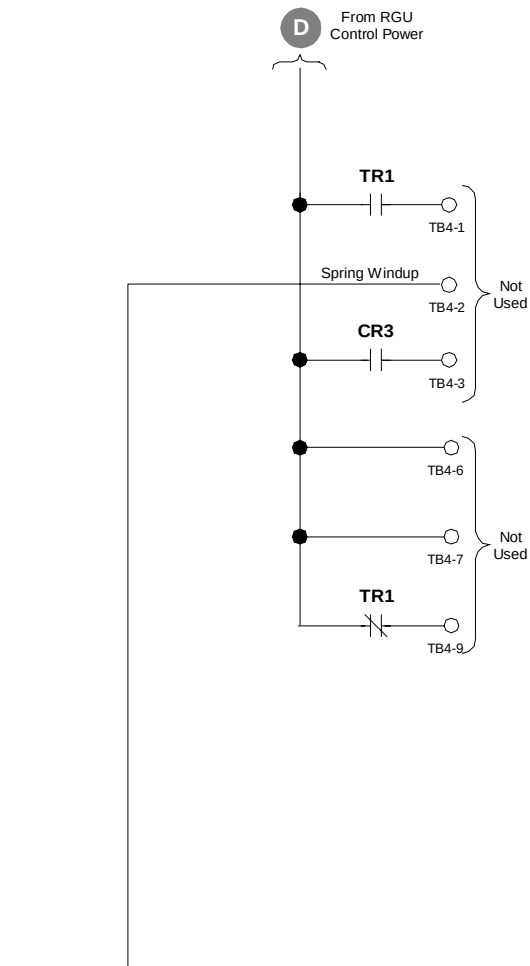
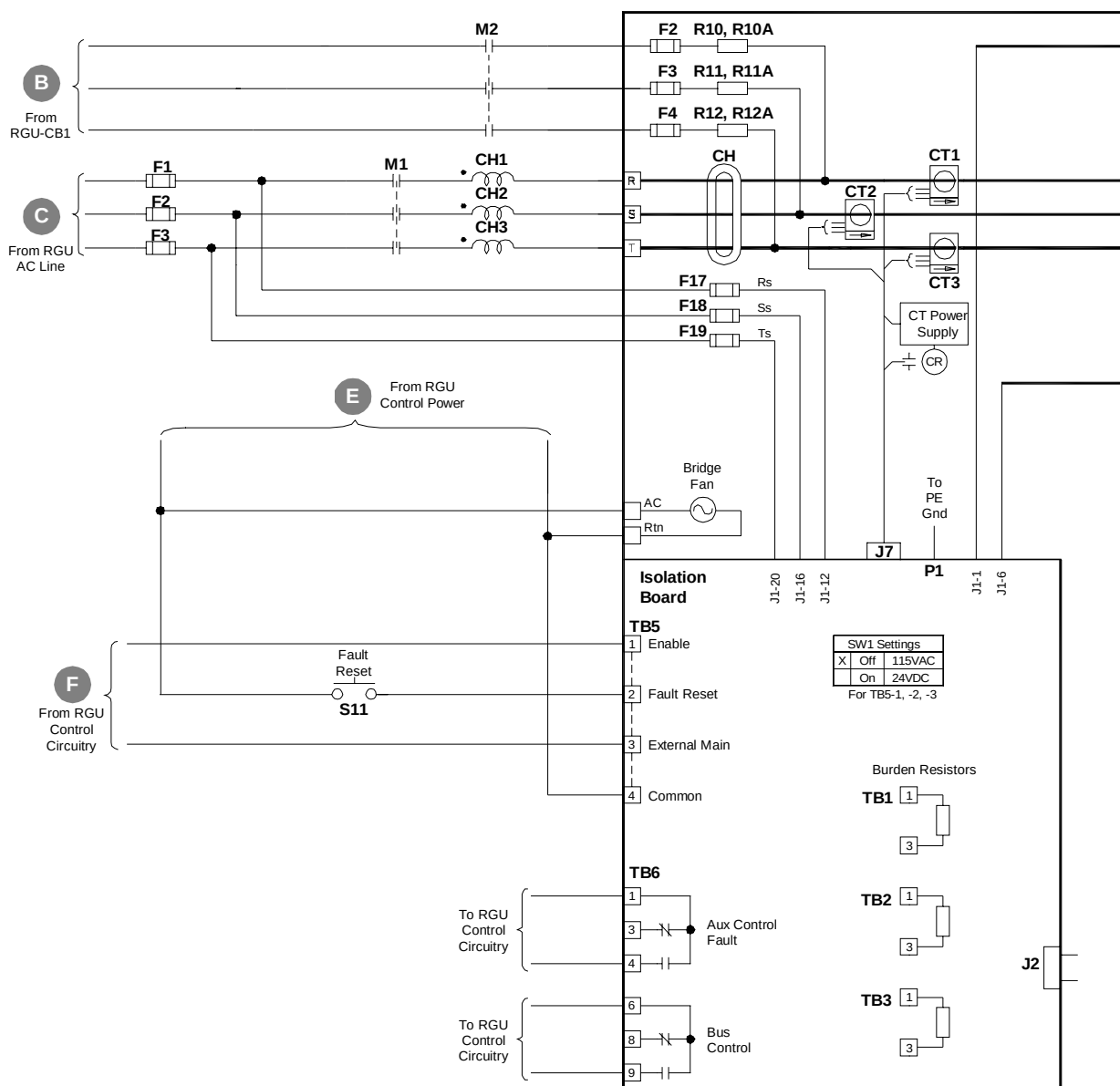


Figure 13.5
Schematics (cont.)



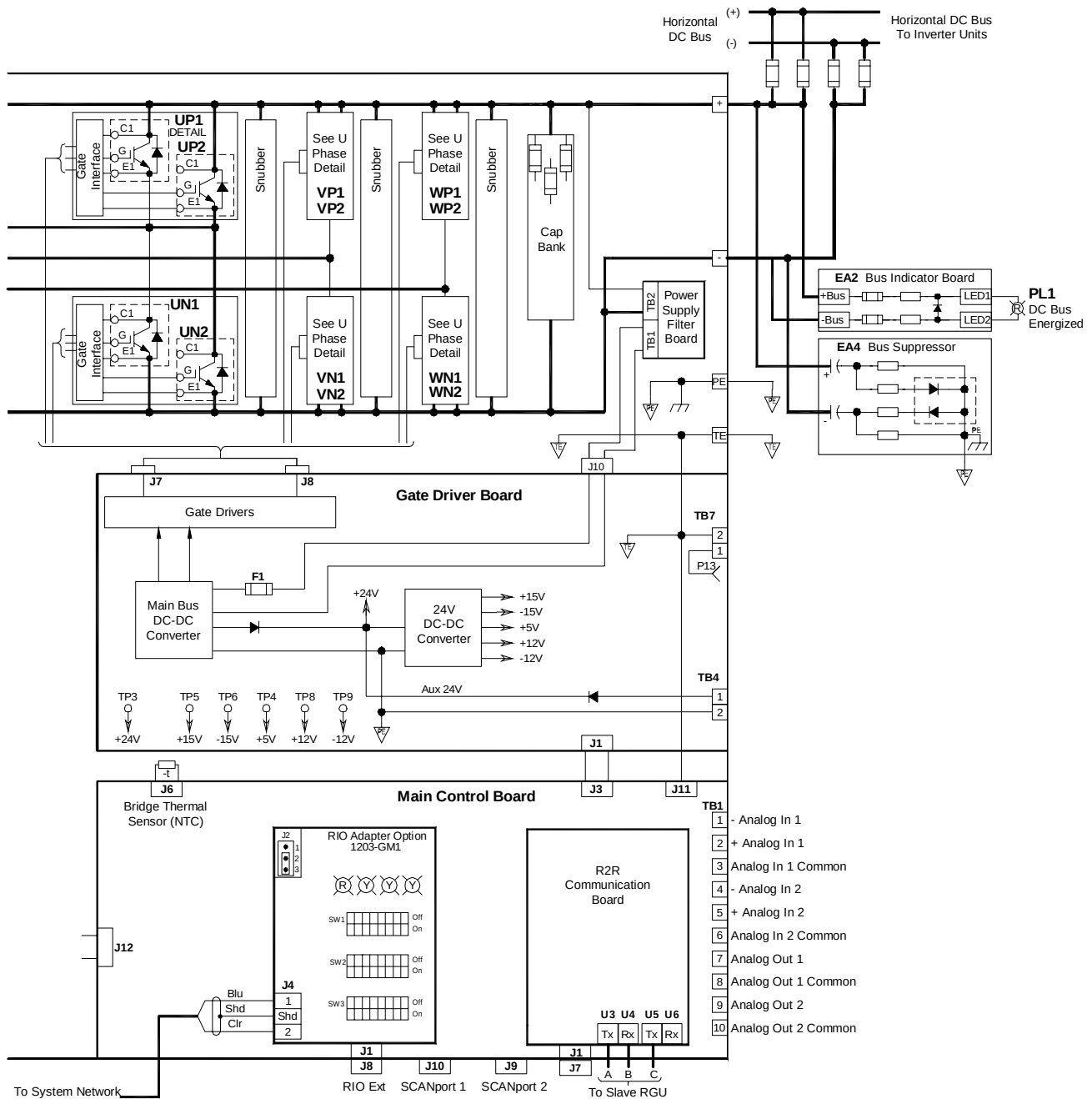
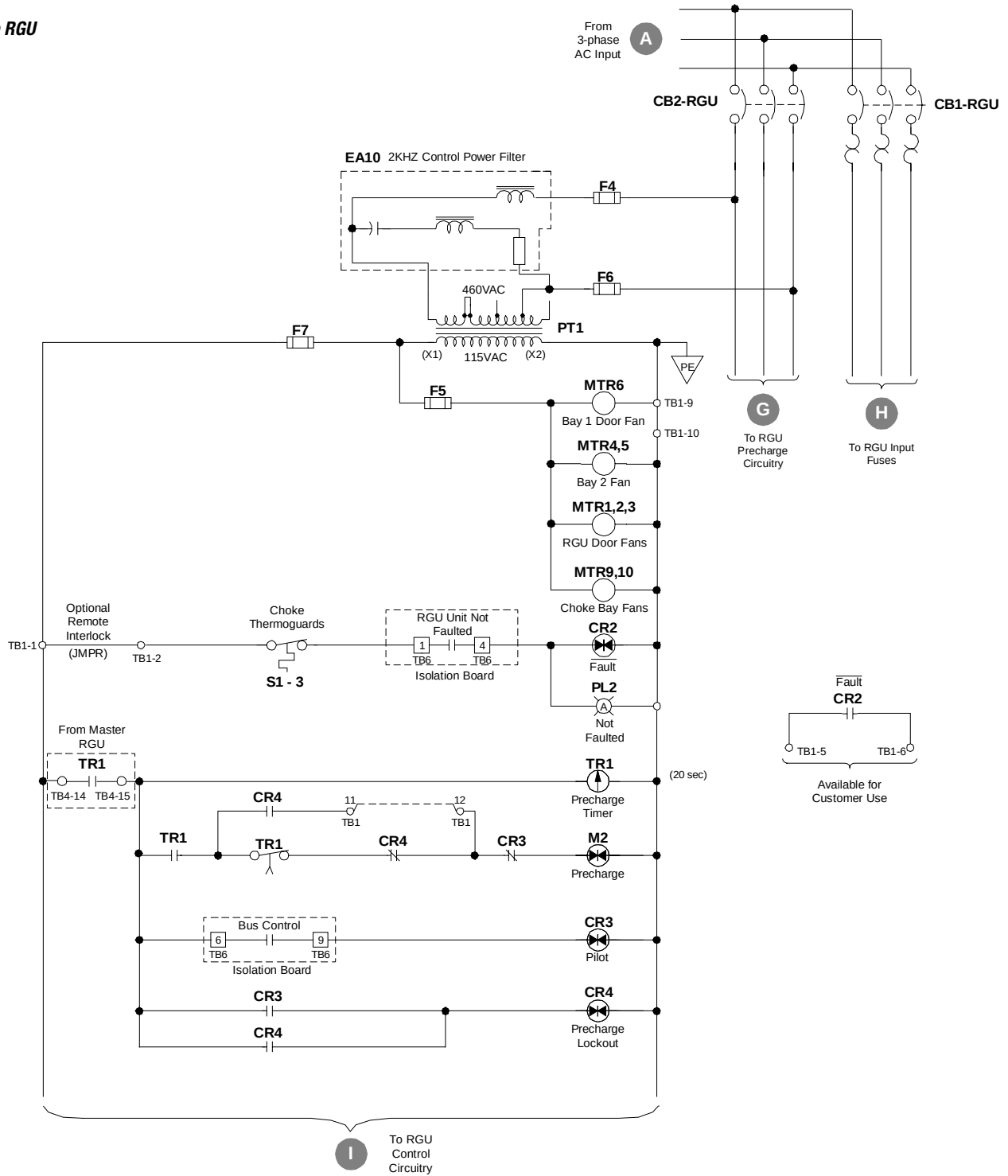


Figure 13.6
Schematics (cont.)

Slave RGU



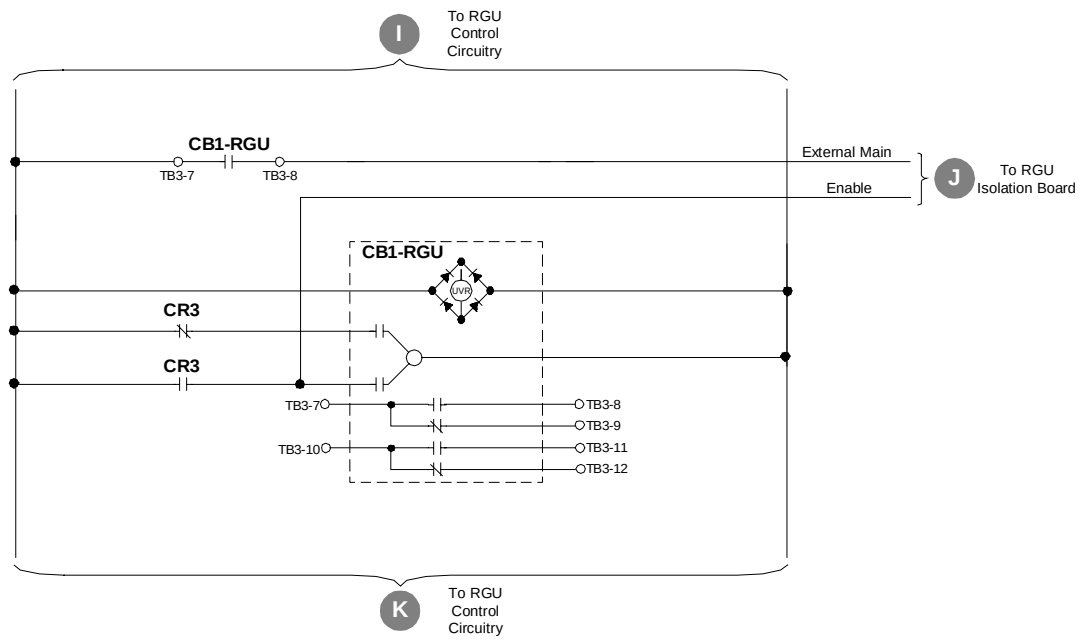
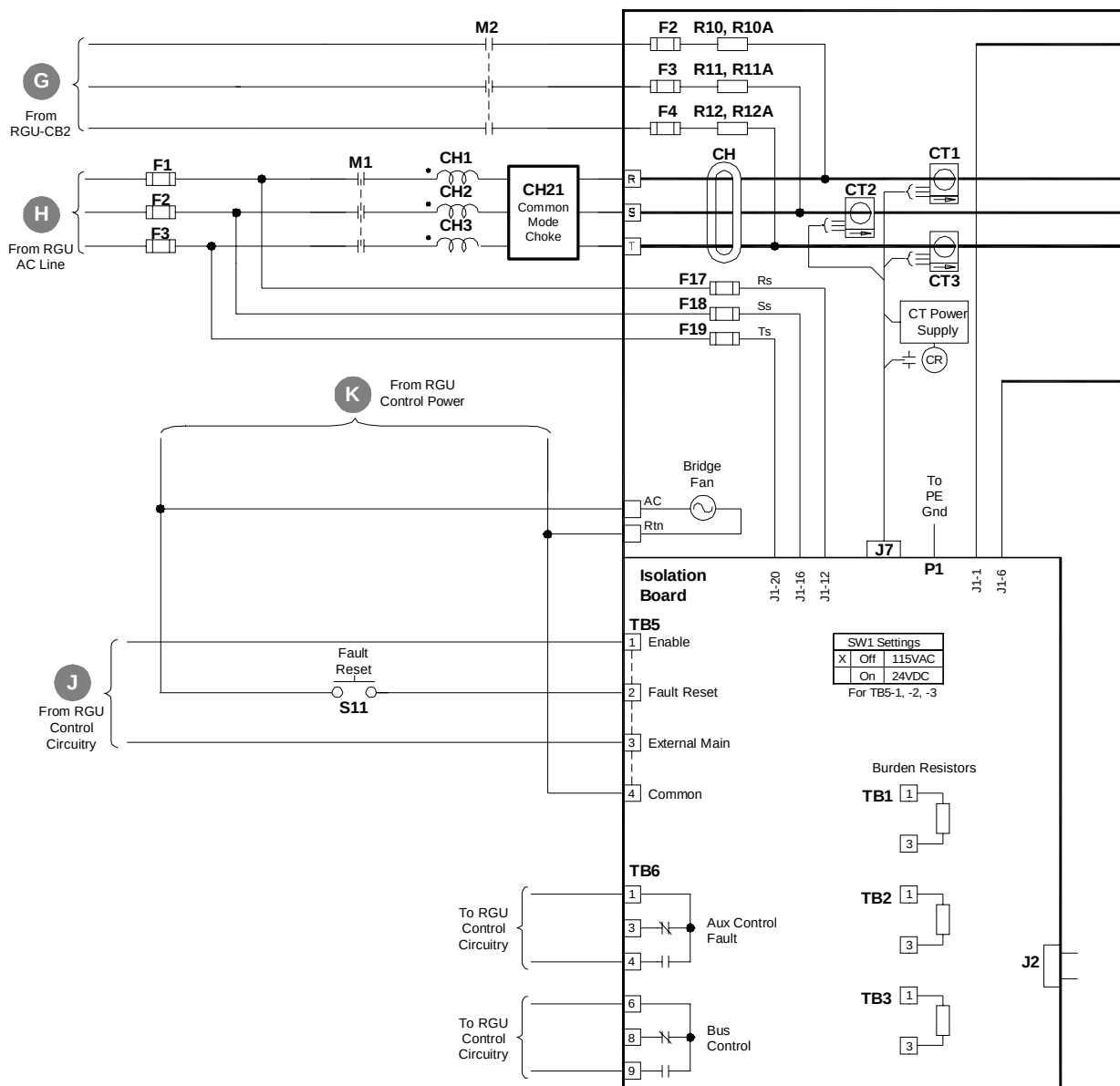
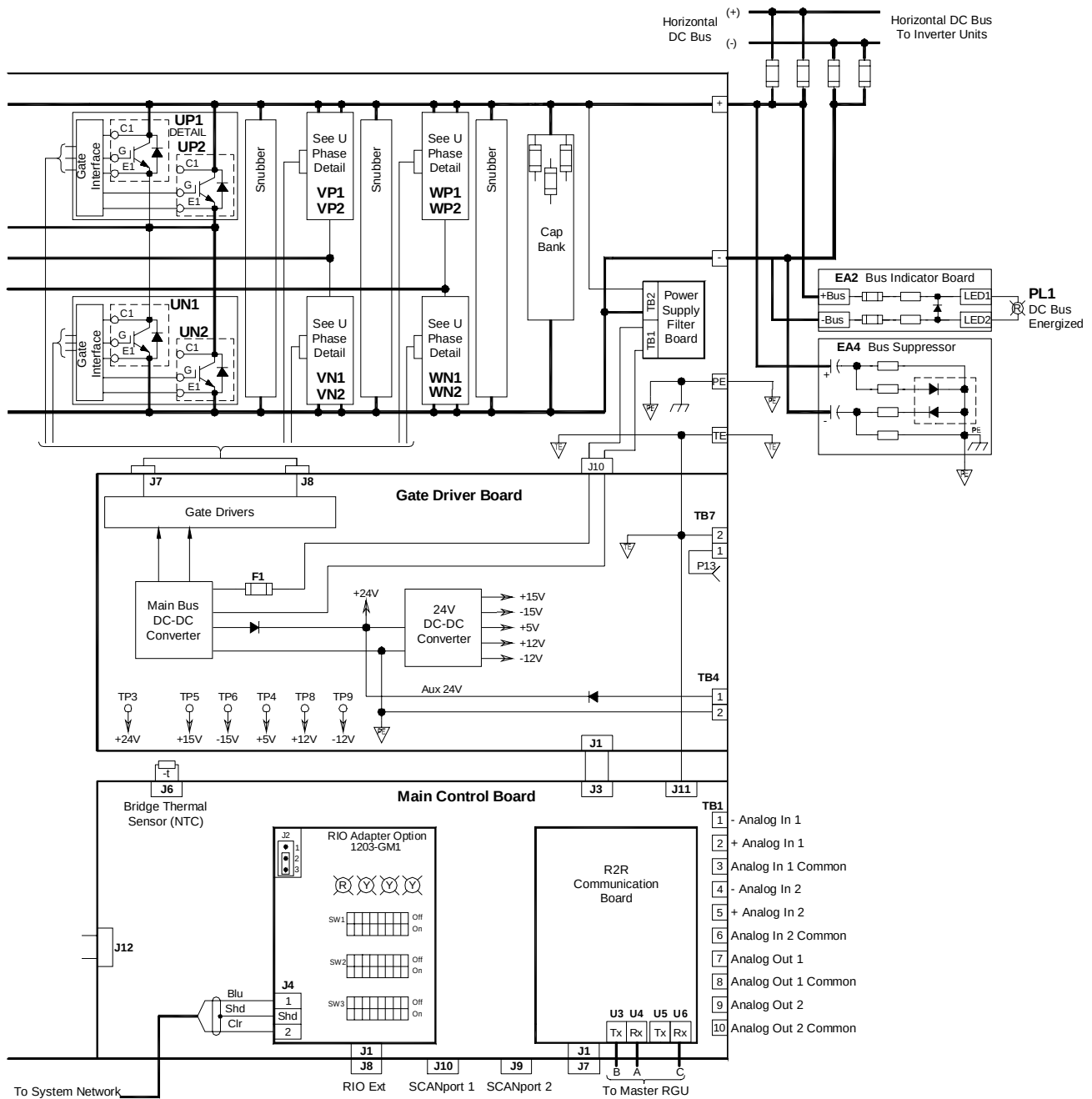


Figure 13.7
Schematics (cont.)

Slave RGU





W3-Code Parallel Configurations

W2-Code Parallel Configuration

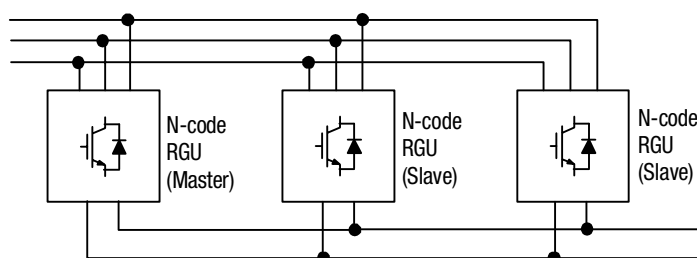
The W3-code parallel configuration is a common DC bus front-end unit consisting of three N-code RGUs.

Figure 14.1
W2-Code Parallel Configuration—Information

V6-code Ratings

Input Voltage (V AC)	DC Bus Current (A DC)	Rated DC Bus kW
380	2991	1735
460	3000	2100
575	2742	2325

V6-code Parallel Configuration

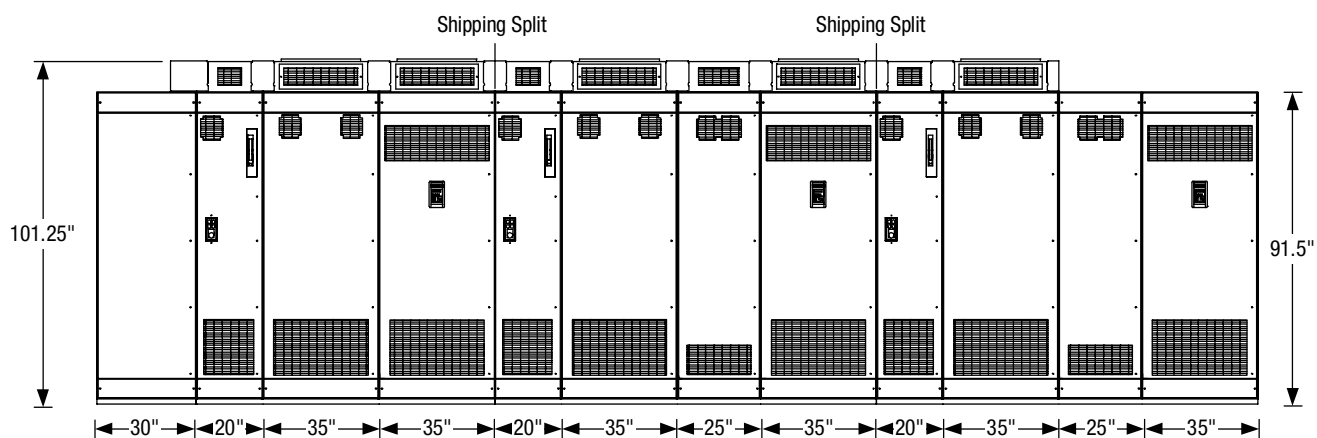


Note: Information for the N-code RGU can be found in publication 2364F-5.01.

Component Layout

Figure 14.2
Enclosure Layout

Front View



Cutaway View

Customer Supplied
AC Input Lines

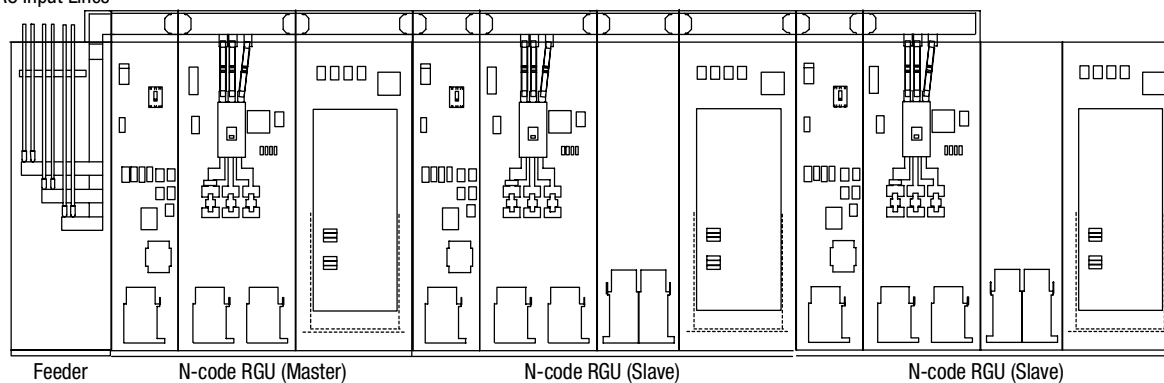
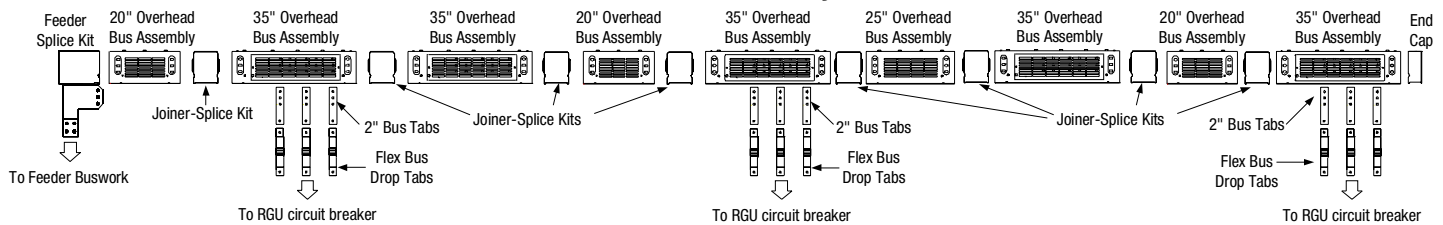


Figure 14.3
Overhead Bus Assembly



New and Revised RGU Components in the W3 Configuration

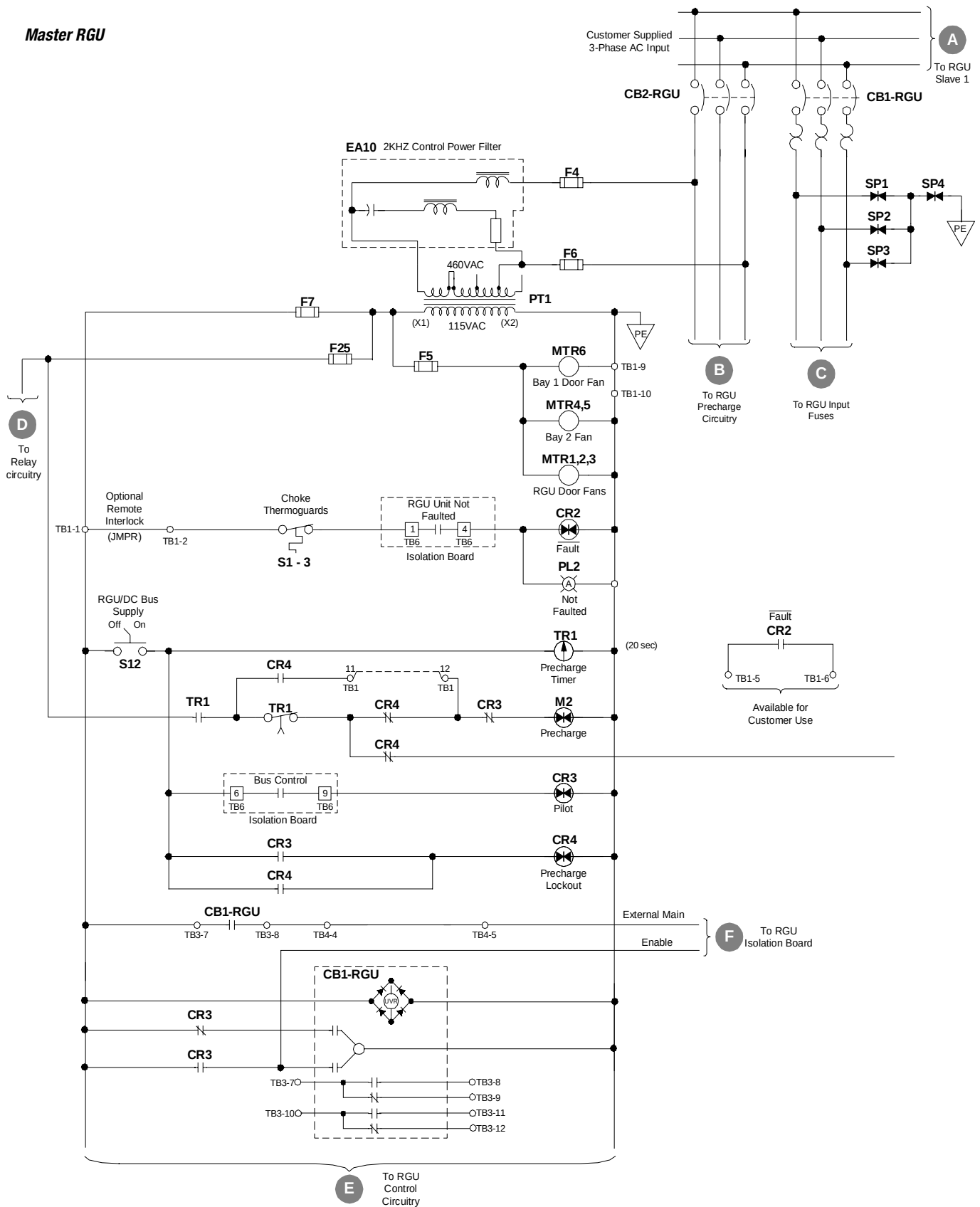
RGU (master)	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA9	R2R Hub Board	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer	Primary fuse for 10kVA control transformer (Opt 6P)
		25A, KLDR (for 380V AC input)	35A, KLDR (for 380V AC input)
		20A, KLDR (for 460V AC input)	30A, KLDR (for 460V AC input)
		17.5A, KLDR (for 575V AC input)	25A, KLDR (for 575V AC input)
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	F25	Fuse, CB1 motor operator, 10A, KLDR	
	PT1	Control power transformer, 5kVA	Control power transformer, 10kVA (Opt 6P)
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
		Fiber optic cable, 3', HP HFBR connector	

RGU (slave A)	CH21	Common Mode Choke, 900A, 4mH	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer	
		25A, KLDR (for 380V AC input)	
		20A, KLDR (for 460V AC input)	
		17.5A, KLDR (for 575V AC input)	
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	MTR9, 10	Fan, choke bay, 6.9", 340 CFM, 115V AC	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
		Fiber optic cable, 26', HP HFBR connector	

RGU (slave B)	CH21	Common Mode Choke, 900A, 4mH	
	CR4	Precharge Lockout Relay (2NO/2NC)	
	EA11	R2R Communication Board	
	F4, F6	Primary fuse for 5kVA transformer	
		25A, KLDR (for 380V AC input)	
		20A, KLDR (for 460V AC input)	
		17.5A, KLDR (for 575V AC input)	
	F21, 21A, 22, 22A	DC bus fuses, 500A, 700V, 170M	
	MTR9, 10	Fan, choke bay, 6.9", 340 CFM, 115V AC	
	PT1	Control power transformer, 5kVA	
	TR1	Timer relay (3NO/1NC)	
	TB4	Control Terminal block, 30A, 600V	
		Fiber optic cable, 34', HP HFBR connector	

Overhead bus assembly

Schematics

Figure 14.4
Schematics

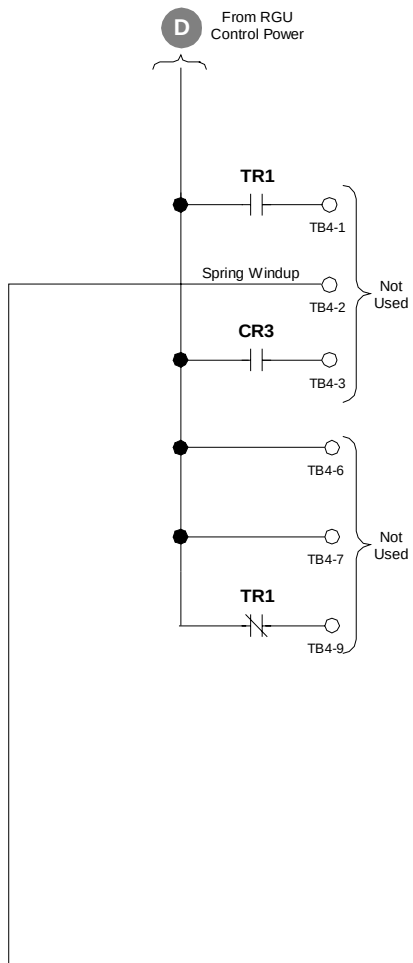
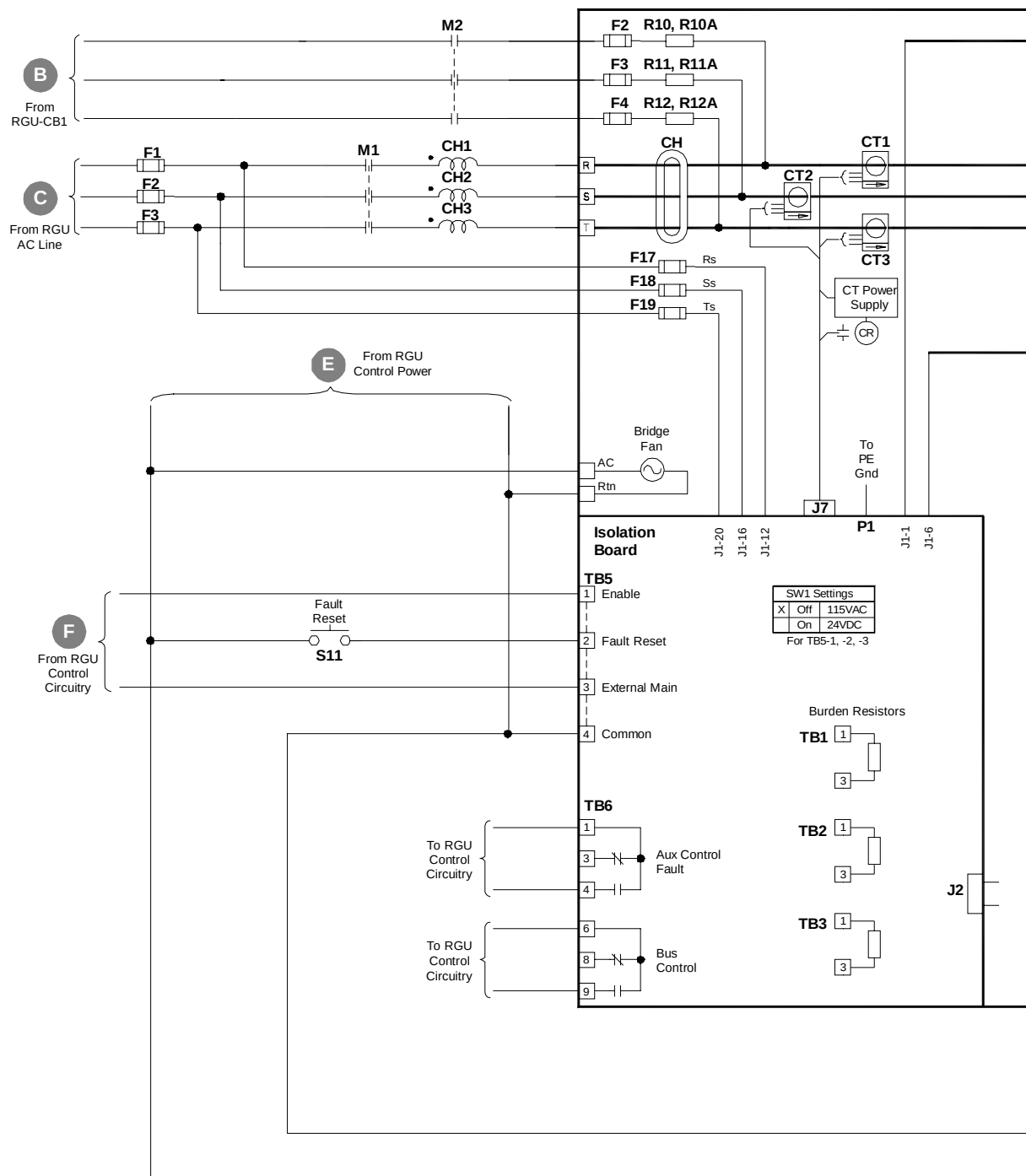


Figure 14.5
Schematics (cont.)



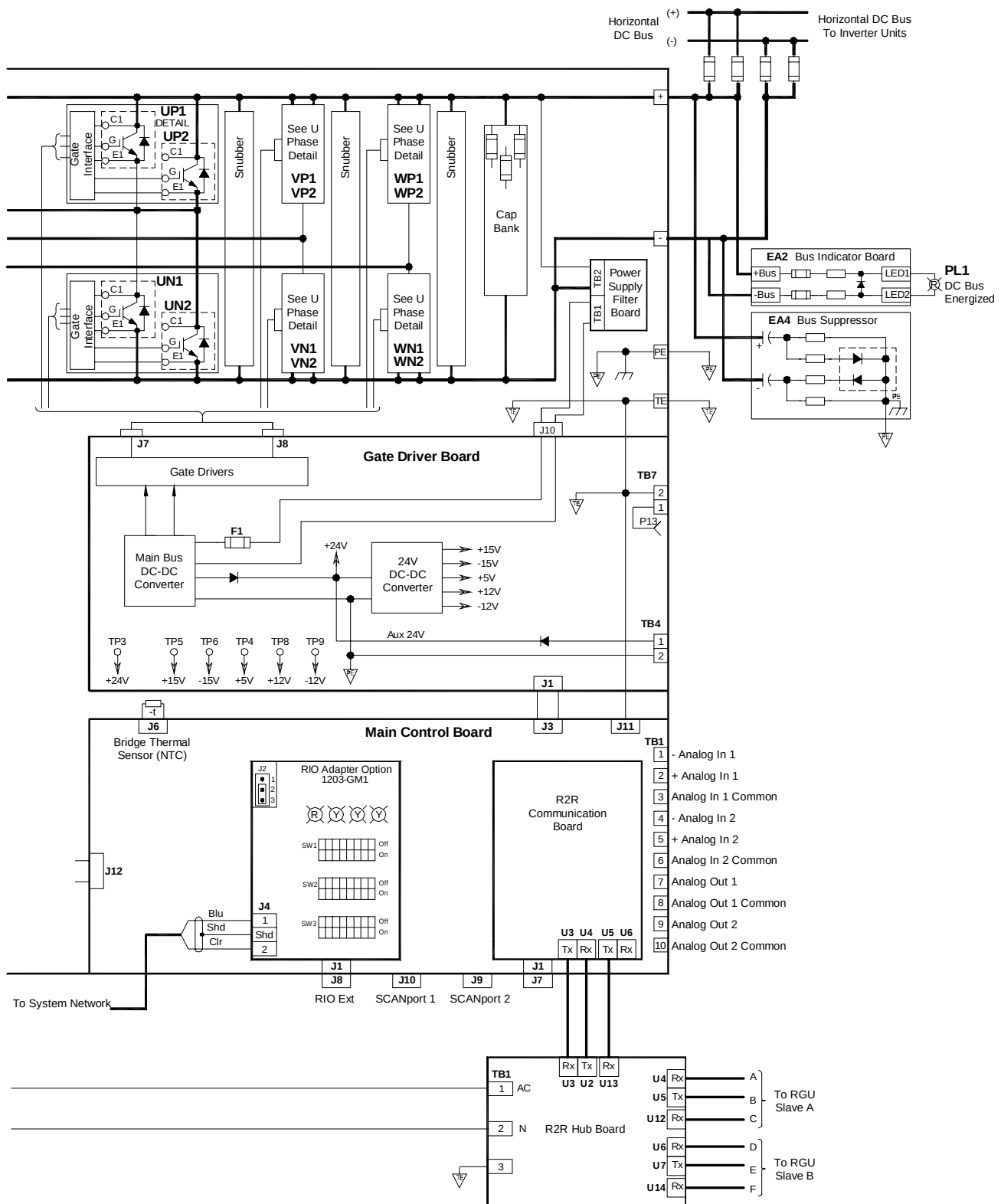
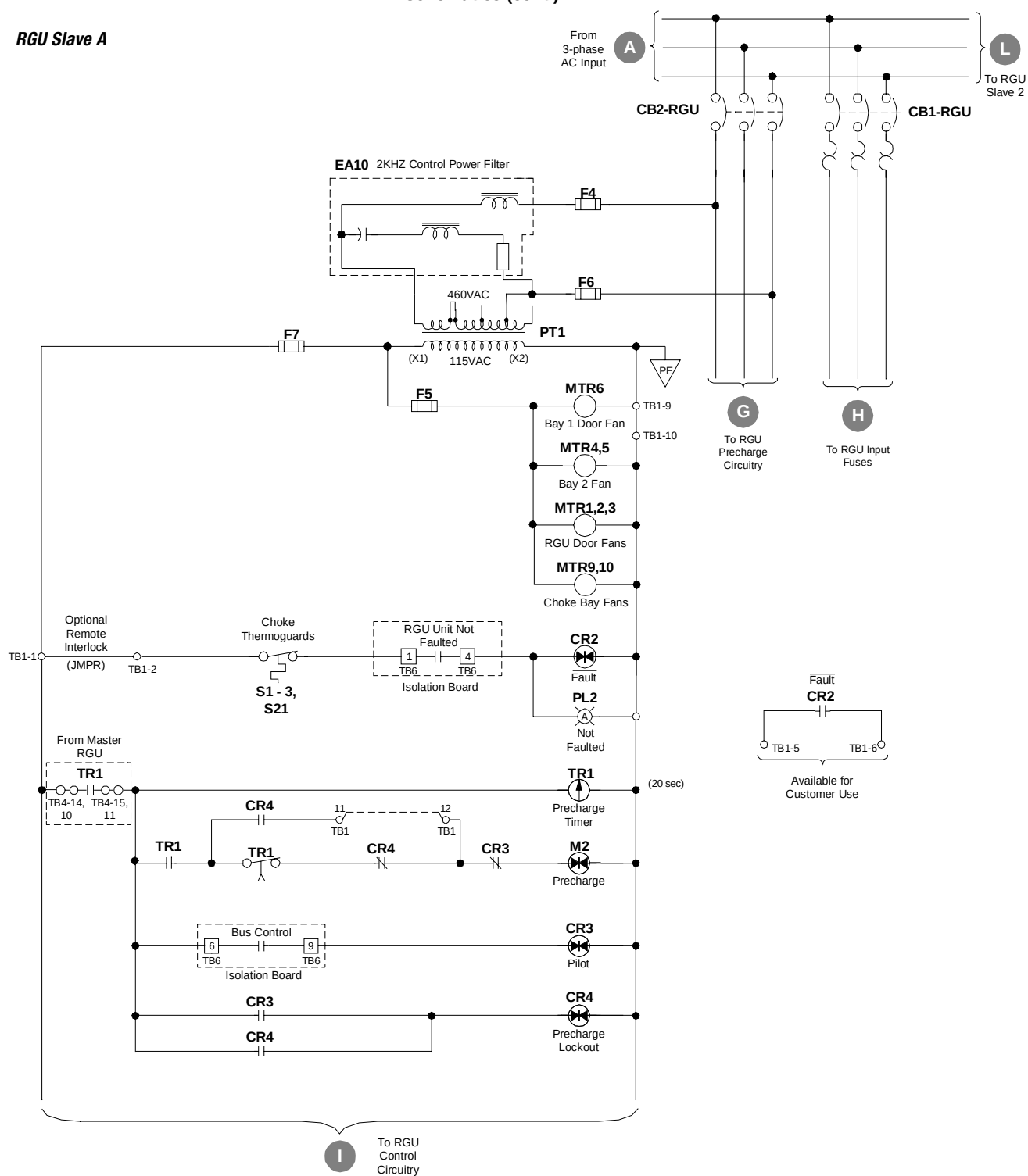


Figure 14.6
Schematics (cont.)

RGU Slave A



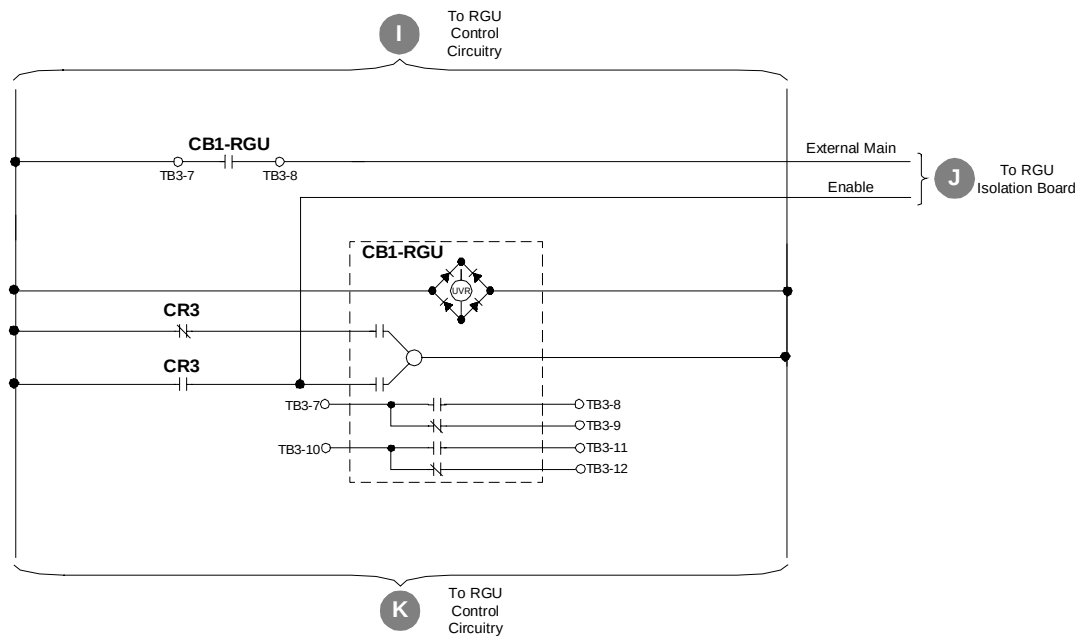
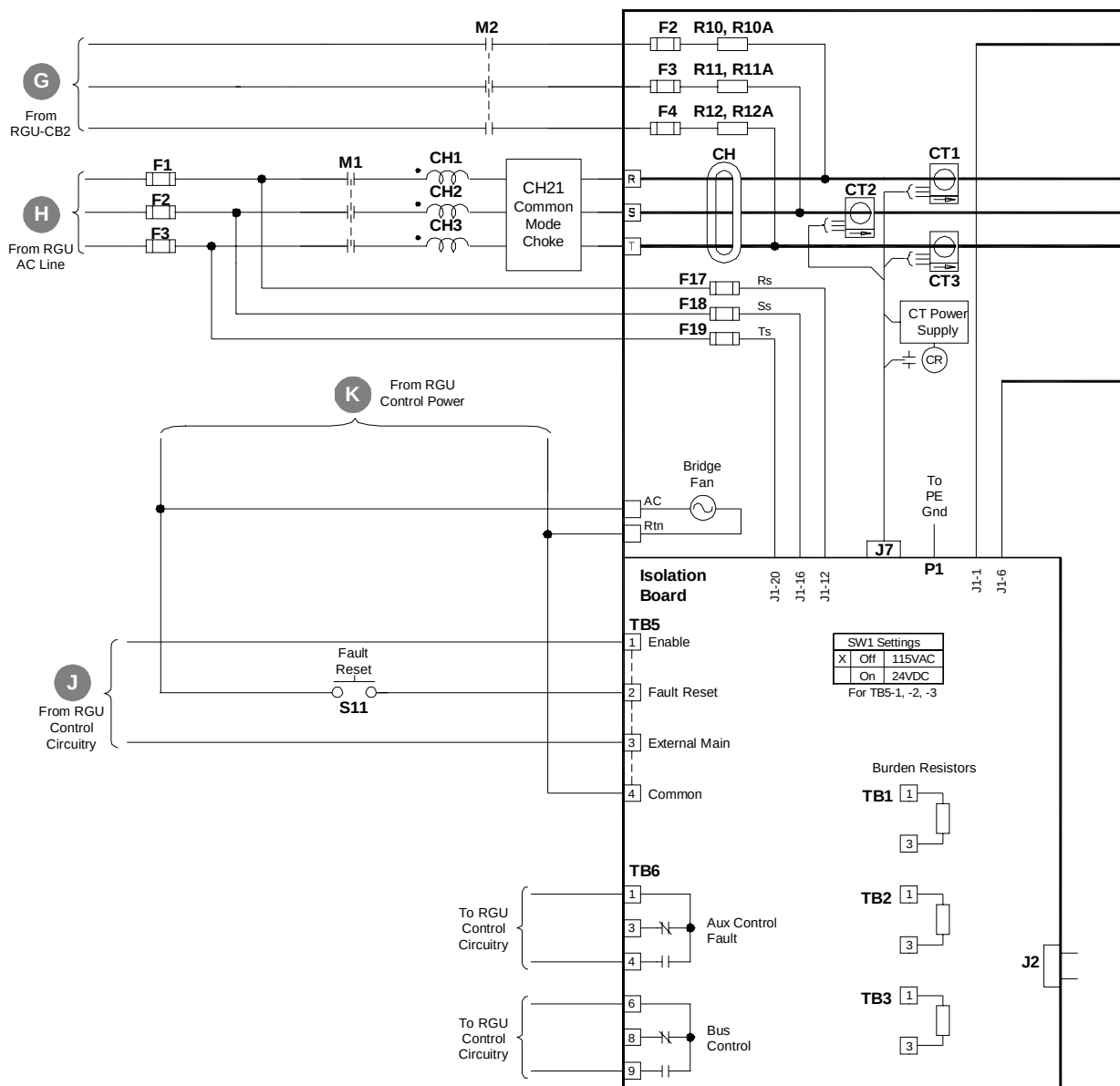


Figure 14.7
Schematics (cont.)



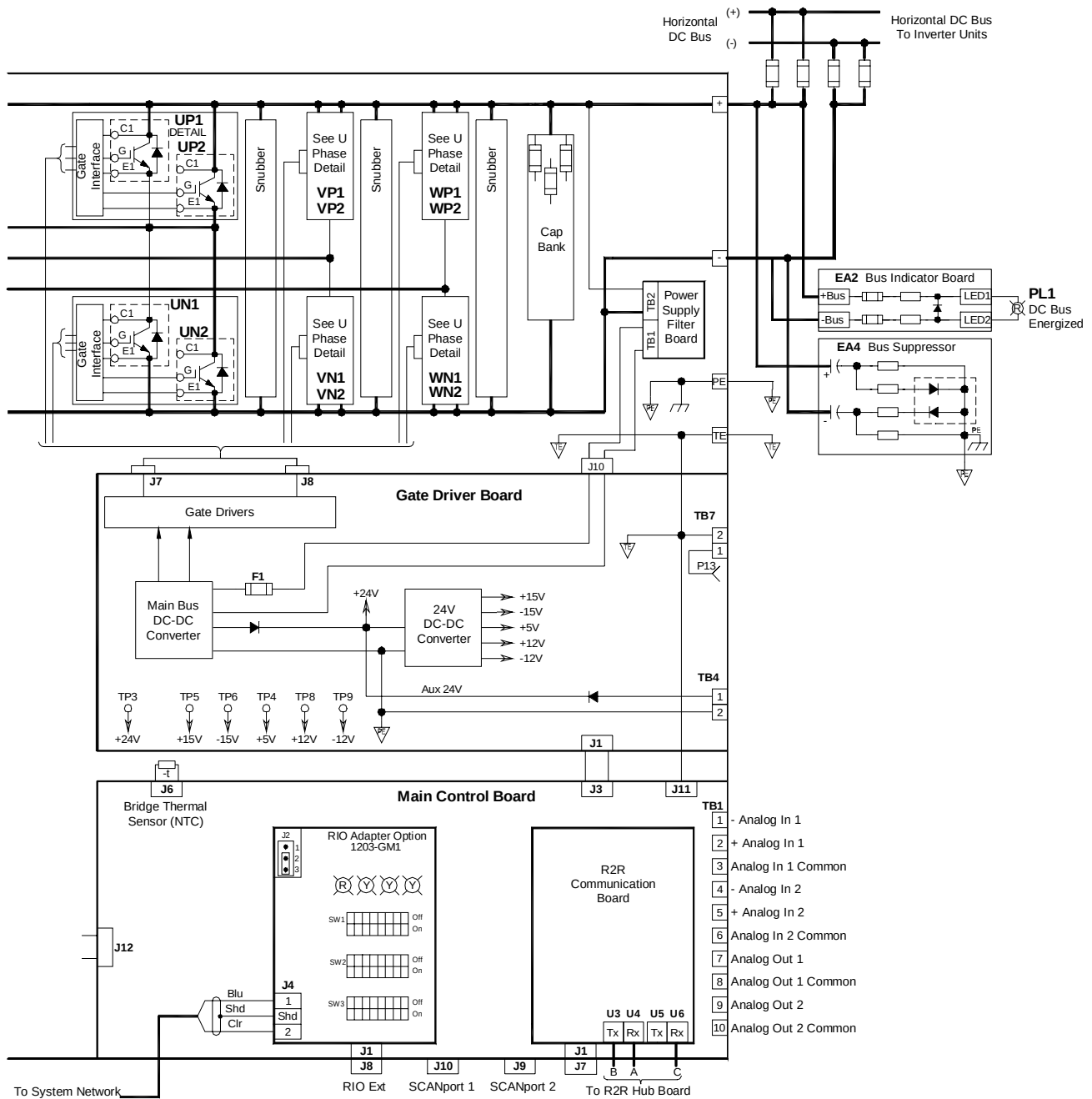
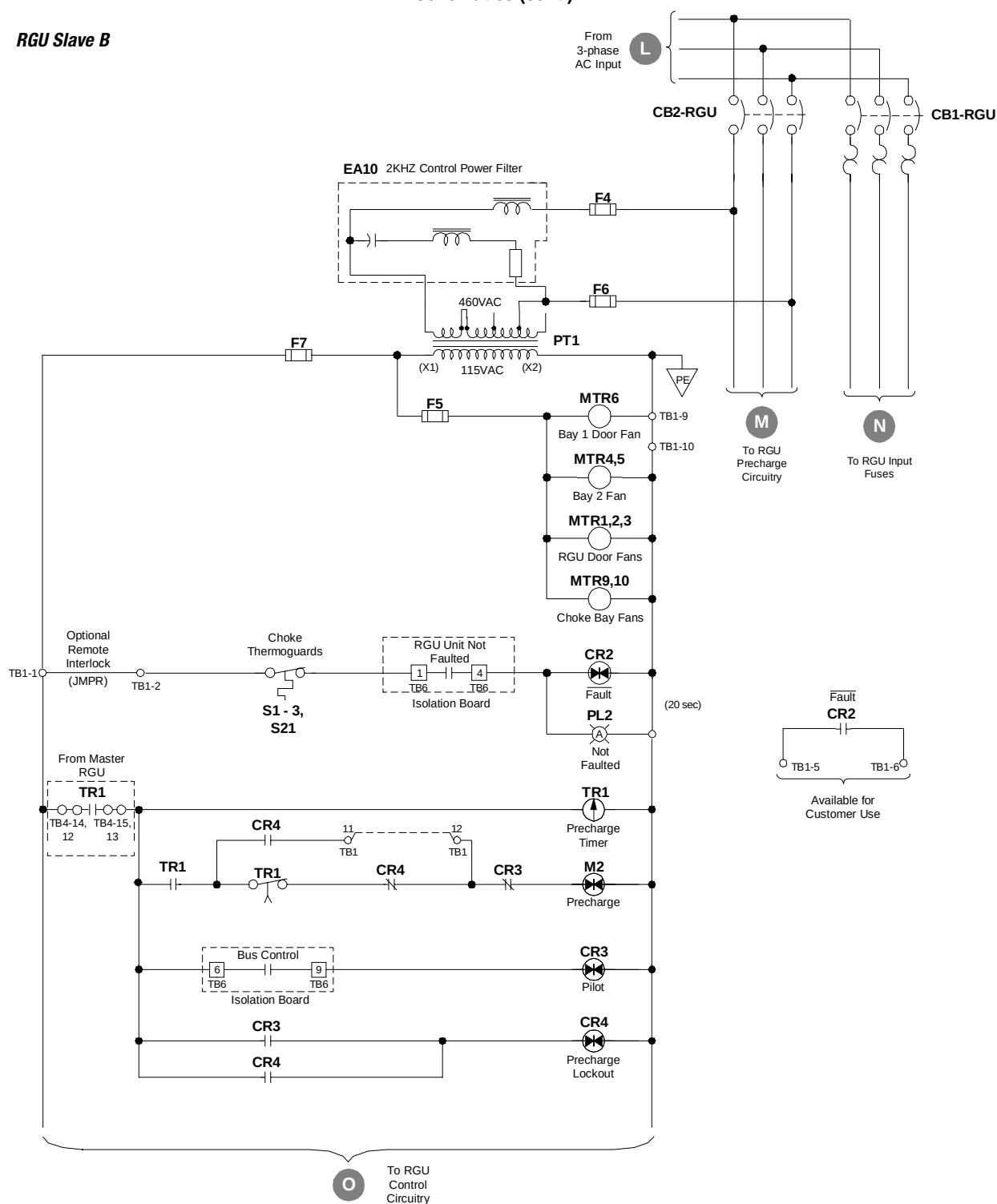


Figure 14.8
Schematics (cont.)

RGU Slave B



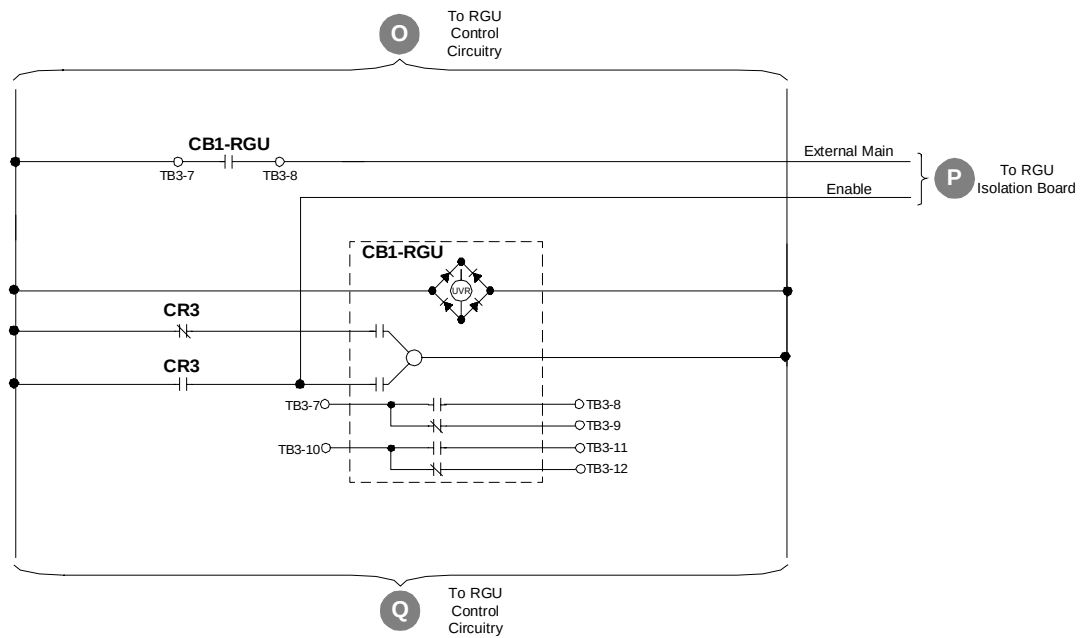
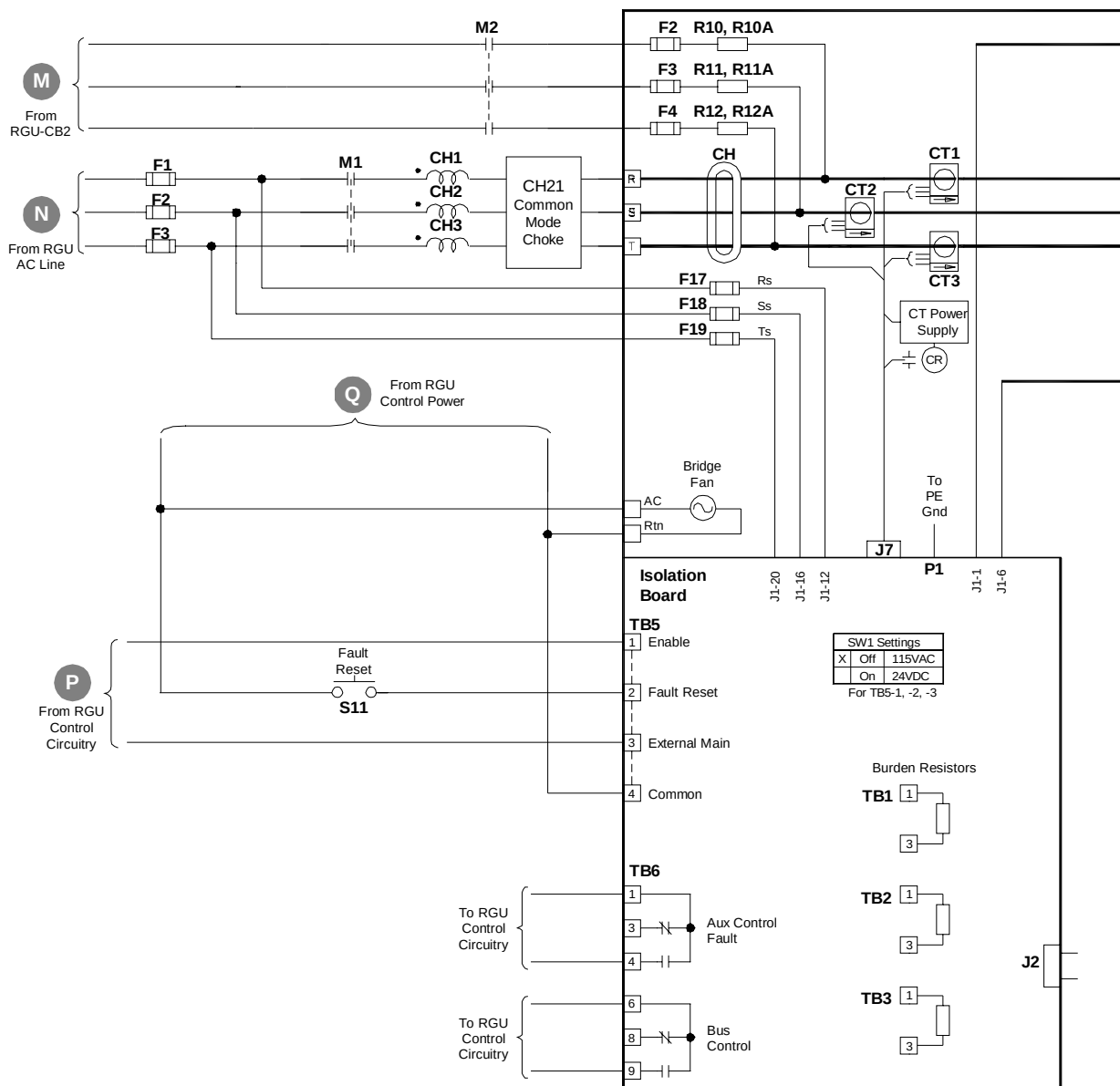
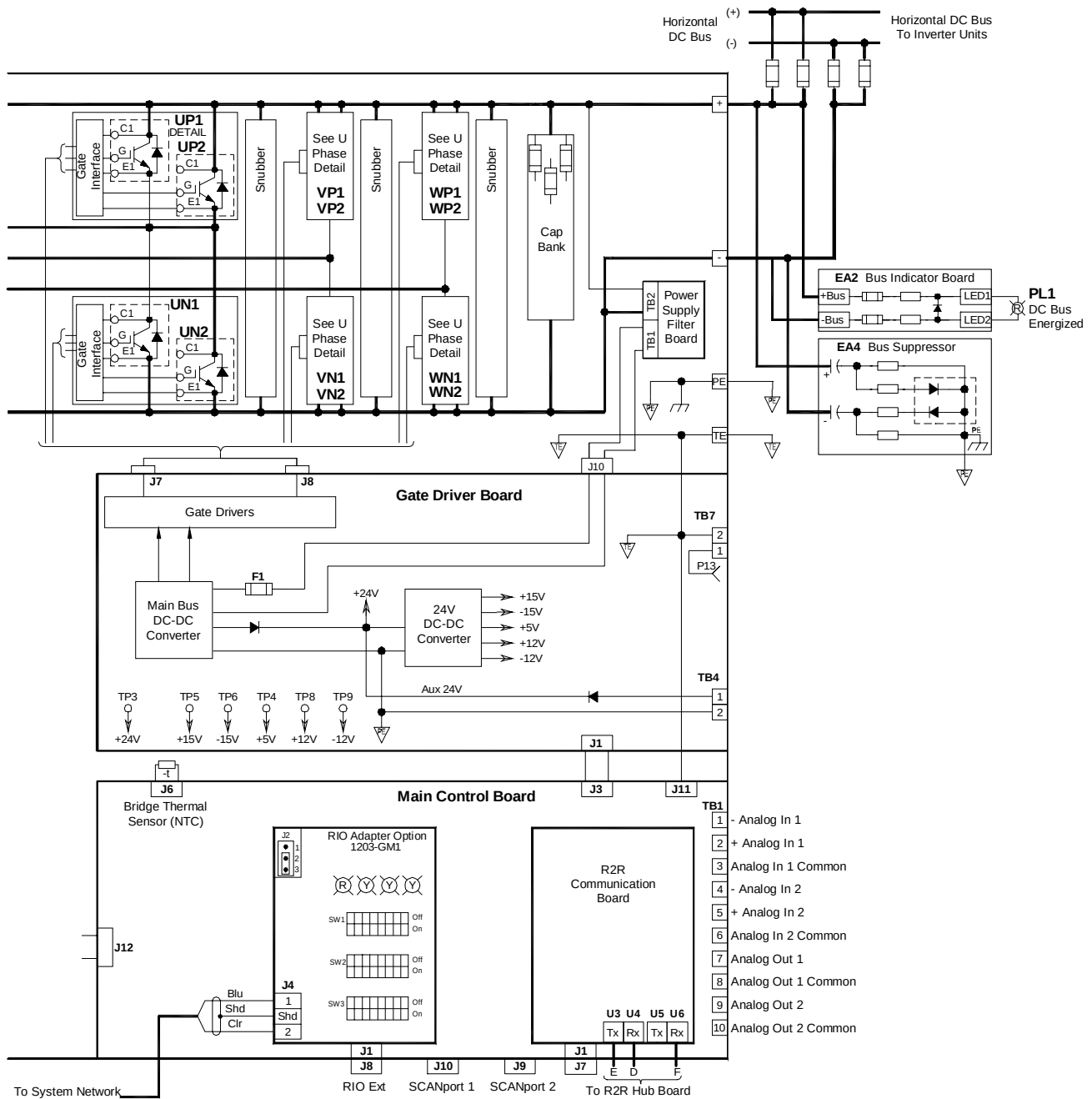


Figure 14.9
Schematics (cont.)

RGU Slave B





Installation

The instructions in this chapter will guide you in properly installing the parallel configuration. The processes include receiving and installing the unit at the designated site, joining enclosures and buswork, installing the overhead bus, connecting internal communications and power wiring, connecting all customer wiring, and connecting AC input. This chapter includes instructions for testing the parallel configuration.

After the installation is complete, follow the setup instructions in the next chapter.

Receiving, Handling, and Installing the Parallel Configuration

Directions for receiving and handling the parallel configurations can be found in publication 2100-5.5, *Receiving, Handling, and Storing Motor Control Centers—Instructions*. Prepare a place suitable for the units according to the system size and the NEMA type ordered.

After the system is in place, follow the directions in publication 2300-5.1, *Bulletin 2300 Family of Drive Systems Hardware—Installation Manual* to join the enclosures and to splice the PE, TE, DC, and control busbars in the system. Refer to publication S-3062, *FD86N Drive Systems Enclosure Hardware—Installation Manual*, if there are any FD86N enclosures in the system.

Make sure that all circuit breakers in the system are in the off position at this time.

Safety Precautions

The following general precautions apply when installing, servicing, or operating parallel configurations and drive system lineups:



ATTENTION: Only those familiar with the drive system, the products used in the system, and the associated machinery should plan or implement the installation, startup, and future maintenance of the system. Failure to comply can result in personal injury and/or equipment damage.

ATTENTION: Verify that all sources of AC and DC power are deenergized and locked out or tagged out in accordance with the requirements of ANSI/NFPA 70E, Part II.

ATTENTION: The system may contain stored energy devices. To avoid the hazard of electrical shock, verify that all voltage on capacitors has been discharged before attempting to service, repair, or remove a drive system or its components. You should only attempt the procedures in this manual if you are qualified to do so and are familiar with solid-state control equipment and the safety procedures in ANSI/NFPA 70E.

ATTENTION: An incorrectly applied or incorrectly installed drive system can result in component damage and/or a reduction in product life. Wiring or application errors—such as undersizing the motor, incorrect or inadequate AC supply, and excessive ambient temperatures—can result in the malfunction of the drive equipment.

ATTENTION: This drive system contains parts and assemblies that are sensitive to ESD (electrostatic discharge). Static control precautions are required when installing, testing, or repairing this assembly. Component damage can result if ESD control procedures are not followed. If you are not familiar with static control procedures, refer to Rockwell Automation publication 8000-4.5.2, *Guarding Against Electrostatic Damage*, or another adequate handbook on ESD protection.

Overhead Bus Installation

The overhead bus provides a common input for all the units in the parallel configuration. If top entry will be used for the feeder bay, make sure to remove the top plate, cut or punch the appropriate area for the AC wiring, and replace the top plate before installing the overhead bus.

To install the overhead bus, refer to the instructions in publication 2364P-5.10, titled *Overhead Bus Installation*.

Note: In R1, R2, S1, and S2-code configurations, the RGU input leads need to be connected to the NRU bus stubs (on NRU circuit breaker).

Internal Wiring

Grounding

The parallel configuration has a PE ground busbar (as shown in Figure 15.1), which allows a single point for grounding the parallel configuration, and the entire system. PE should be connected to the nearest building steel or substation ground using the appropriate wire (consult the applicable electrical code, i.e. Table 250-59, NEC).

To simplify your grounding arrangement, you can splice the system ground bus to PE, and connect any external device grounds to PE.

The parallel configuration also has a TE busbar (as shown in Figure 15.1), which is attached for grounding control signal shielding in the system. TE should be connected to a separate earth ground at least 10 feet from the PE ground point (see Figure 15.2).

For wire sizes and additional grounding specifications, consult the applicable electrical code documentation (i.e. Table 250-95, NEC).

Figure 15.1
PE and TE Busbars

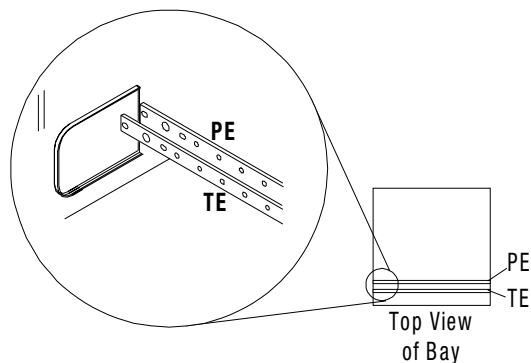
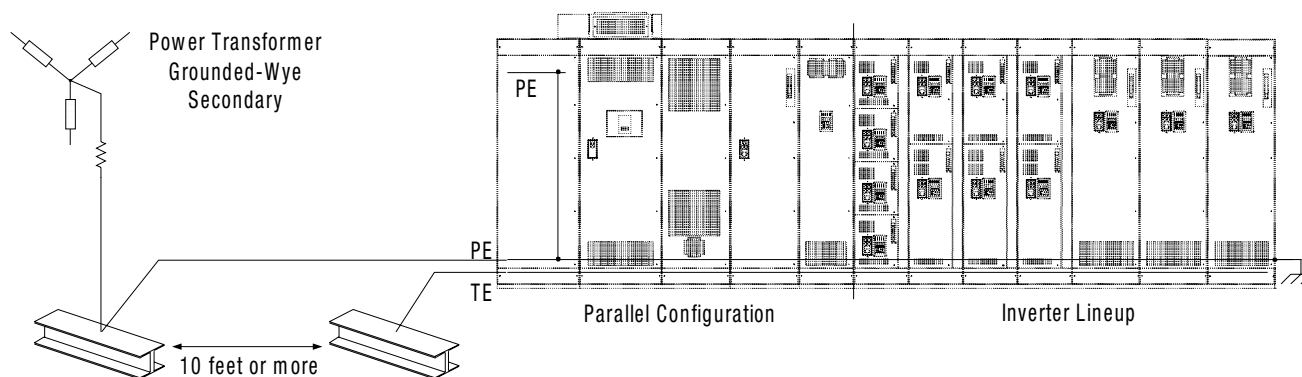


Figure 15.2
Grounding



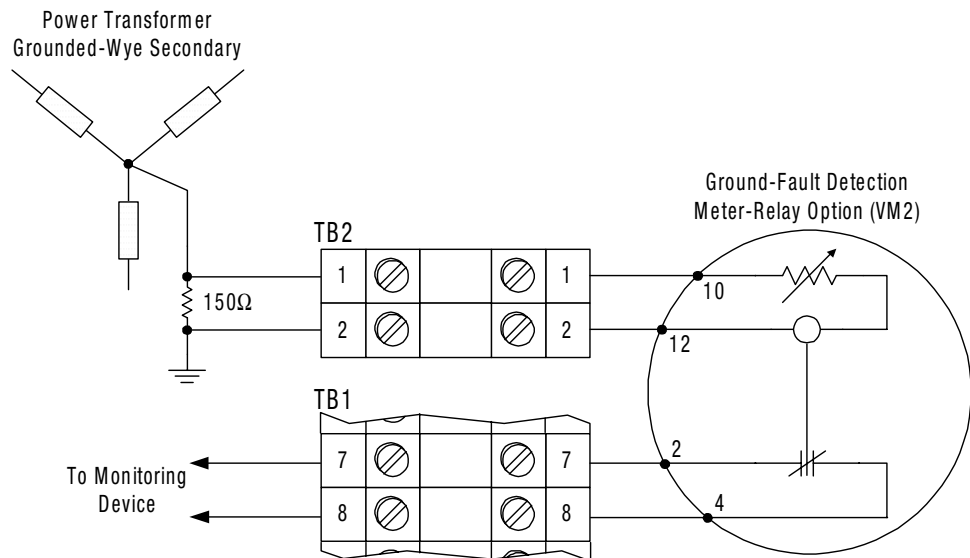
For specific grounding instructions for inverters, motors, and other system components, refer to the system schematics or the designated component manuals.

Ground-Fault Detection Option

The parallel configuration may include the optional ground-fault detector. When configured properly, this detector will indicate the ground voltage on the door-mounted meter, and will energize the relay (with NO/NC contacts) in the event of an excessive ground voltage.

To configure the ground-fault detection relay, wire terminals TB2-1 and TB2-2 across the power transformer grounding resistor (in accordance with system schematics and transformer manufacturer specifications). Terminals TB1-7 and TB1-8 can be wired to an appropriate monitoring device, if desired.

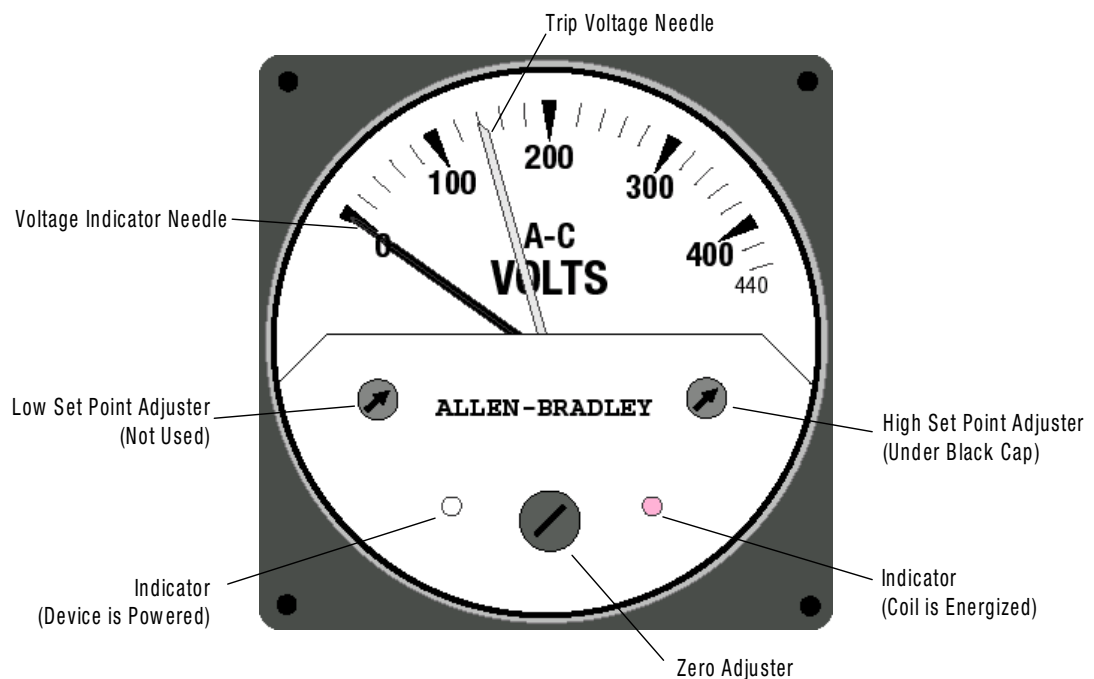
Figure 15.3
Ground-Fault Detection (Wiring)



To calibrate the meter, turn the zero adjuster until the voltage indicator needle (black) is aligned with the zero mark.

To set the trip point (for the detector relay), turn the high-set adjuster until the orange needle points to the appropriate trip voltage. The trip voltage should be approximately 50V higher than the maximum reading on the meter when all the common bus inverters are modulating.

Figure 15.4
Ground-Fault Detection (Meter)



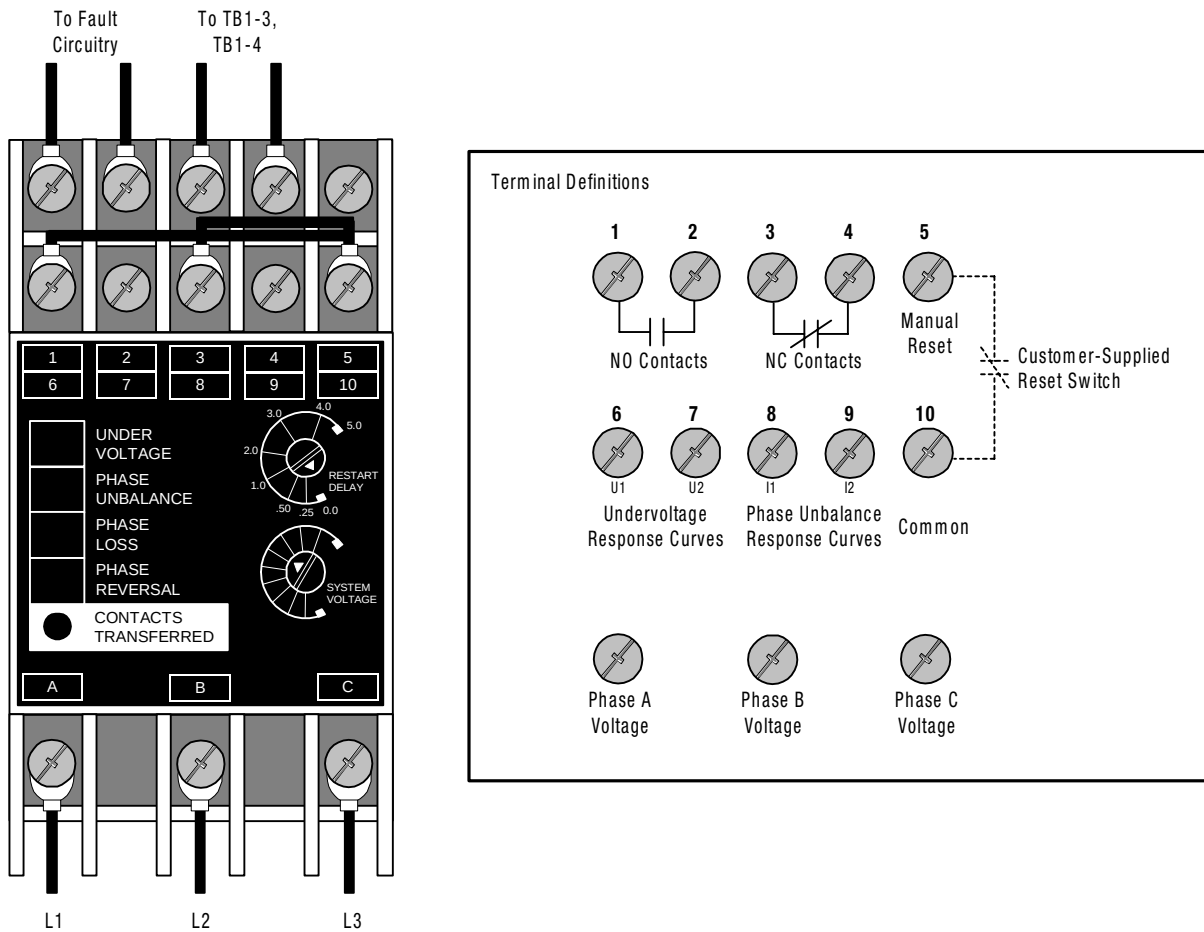
The meter will typically indicate a low voltage value (between 80 and 100V) when the inverters on the DC bus are modulating. This voltage is produced by capacitively coupled currents to ground in the motor's cables and windings.

For more details on the detector wiring for your configuration, see the system schematics. For other detector functions (such as normally-open contacts), see the detector documentation or the detector label.

Phase-Loss Relay

An NRU in the parallel configuration will be equipped with a phase-loss relay, which is used to indicate phase loss, phase unbalance, undervoltage, phase reversal conditions in the 3-phase AC line. The relay has NO/NC contacts, connections for a reset control, and jumper connections for setting undervoltage and phase unbalance tolerances. The relay LEDs indicate AC line conditions and change of state in the relay.

Figure 15.5
Phase Loss Relay



The system voltage dial should be set to the nominal AC line voltage, and a restart delay of 0.0 minutes is recommended. Typically, the normally-open contacts (terminals 1 and 2) will be wired to the fault circuitry in the NRU, and the normally-closed contacts (terminals 3 and 4) will be wired to TB1-3 and TB1-4 for customer connection.

The phase unbalance and undervoltage thresholds are set by the jumper configuration across terminals 6 through 10. The following illustration shows how to jumper the relay for different threshold settings.

Figure 15.6
Jumpers Settings for Phase Imbalance and Undervoltage Thresholds

Phase Unbalance Threshold	Terminal Numbers				
	6	7	8	9	10
5.0%					
6.5%					
8.0%*					
10.0%					

* Typical factory setting is 8.0%.

Undervoltage Threshold	Terminal Numbers				
	6	7	8	9	10
10.0%					
14.0%					
17.0%*					
20.0%					

* Typical factory setting is 17.0%.

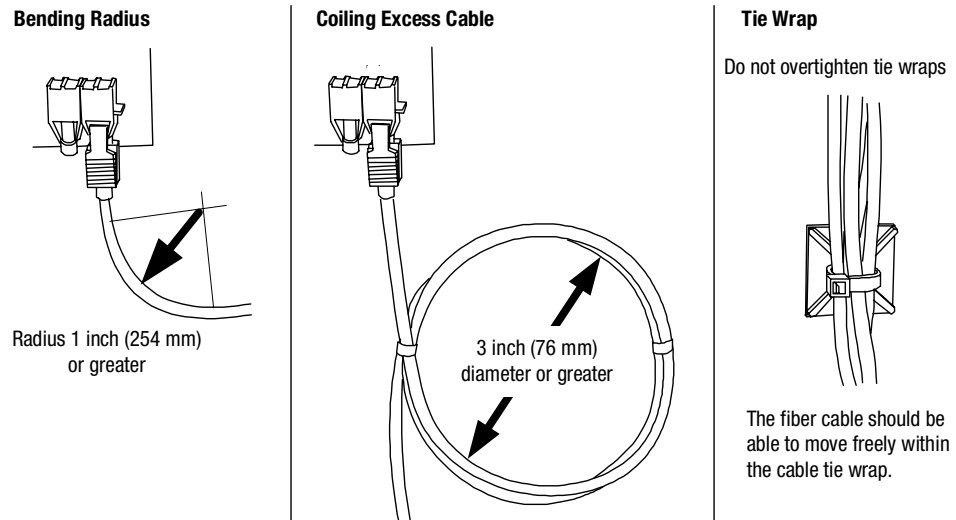
The typical factory setting, for example, has terminals 6, 8, and 10 jumpered together.

RGU-to-RGU (R2R) Communications

If more than one RGU is in the parallel configuration, an RGU-to-RGU (R2R) communications link will be used to transmit current commands and status information from the master unit to the slave unit(s). The fiber optic cables for R2R communications will be coiled in the slave RGUs.

When working with the fiber optic cables, please note the precautions in Figure 15.7.

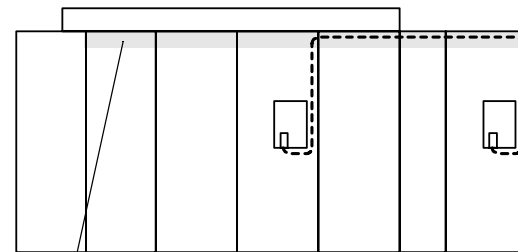
Figure 15.7
Wiring Guidelines



Figures 15.8 and 15.9 show the routing path and connection scheme that should be used when connecting the R2R fiber optic cables.

Figure 15.8
R2R Fiber Optic Cables—Routing Paths

Routing Path - Master With One Slave



Routing Path - Master With Two Slaves

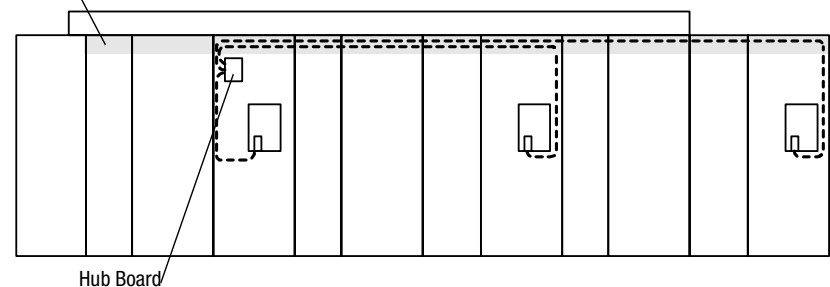
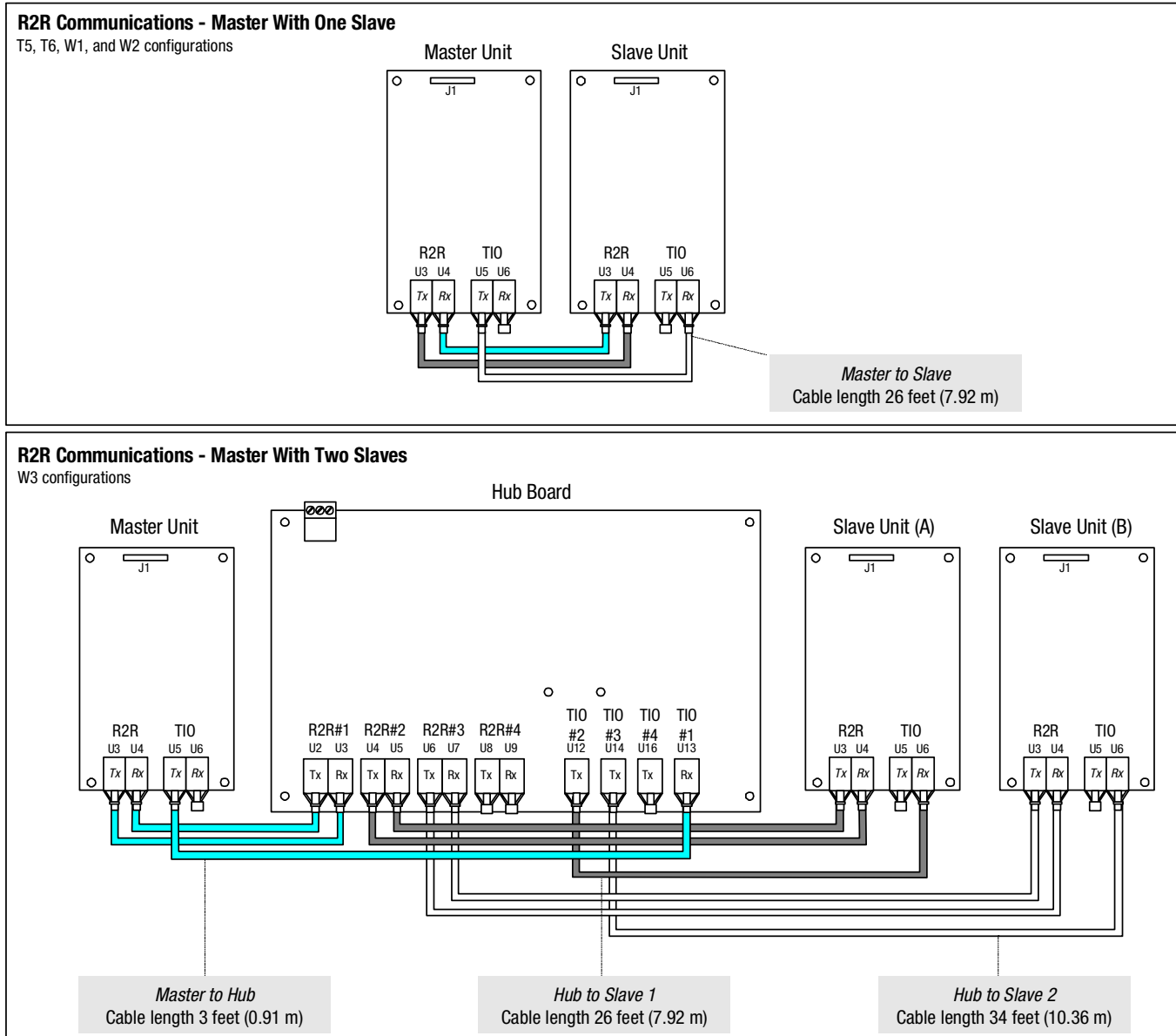


Figure 15.9
RGU-to-RGU (R2R) Communication Wiring



Inspection Precaution: Sharp bends, kinks, and deep nicks in the cable may greatly affect cable performance. Consider replacing the cables if they are not in good condition.

Troubleshooting Tip: To test a fiber optic cable, flash a light through one end of the cable and see if the light comes out the other end.

Customer Connections

Analog Input/Output (RGU Main Control Board)

Analog input and output connections are available on TB1 of the main control board (RGU).

Figure 15.10

Customer Connections–TB1 (RGU Main Control Board)

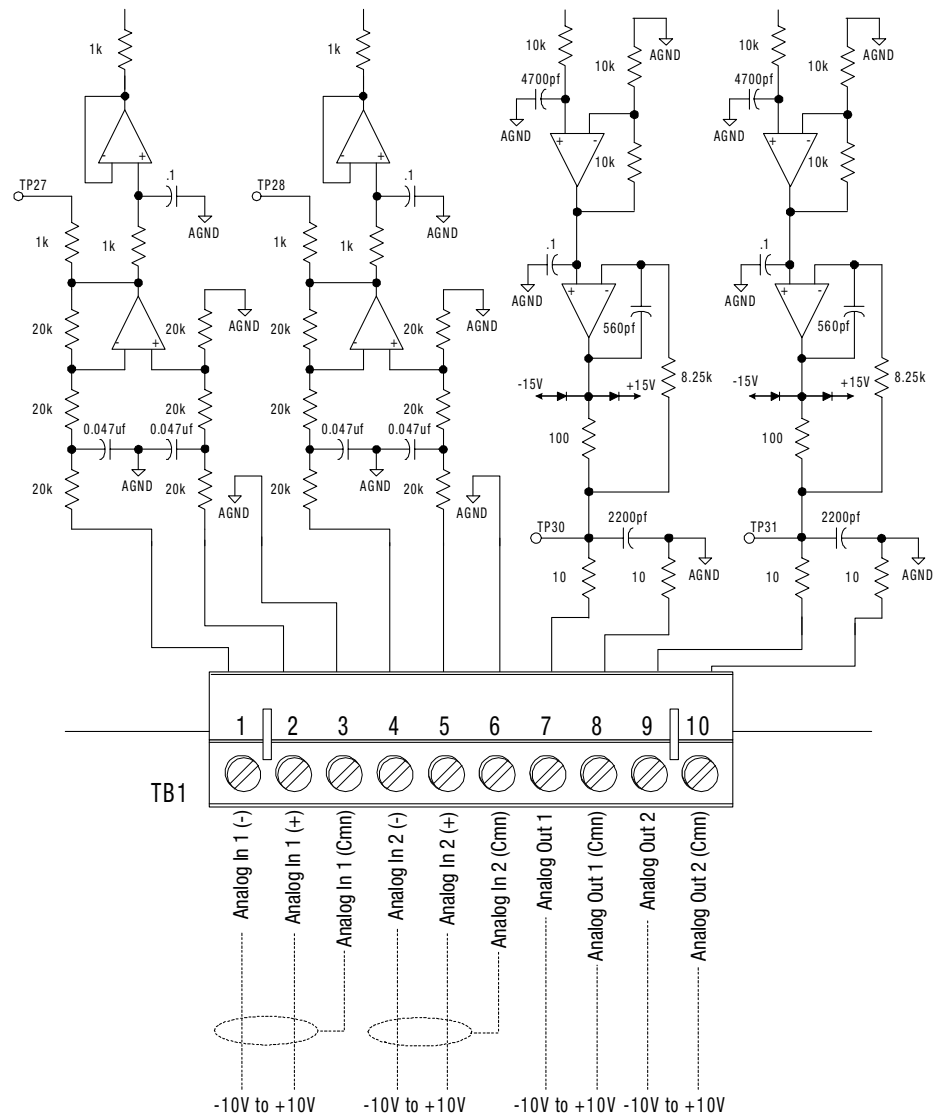


Table 15.A: Customer Connections–TB1 (RGU Main Control Board)

Terminals	Description
TB1-1, TB1-2, TB1-3 TB1-4, TB1-5, TB1-6	Terminals TB1-1, 2, 3 are designated to Analog Input 1 and TB1-4, 5, 6 are designated to Analog Input 2. These can be connected to a customer device which sends signals between $\pm 10V$. The analog voltage supplied is sampled by a 14-bit analog-to-digital converter, and the resulting value is stored in parameter P36 (A/D Converter 0 Input). The internal circuitry has an 80k differential input resistance and a 40k common-mode input resistance. 14AWG wiring is recommended for customer connection.
TB1-7, TB1-8 TB1-9, TB1-10	Terminals TB1-7 and TB1-8 supply analog output from parameter P47 (D/A Converter 1 Output); TB1-9 and TB1-10 supply analog output from parameter P48 (D/A Converter 2 Output). The RGU can be programmed to report parameter values (such as trend parameters) to the customer device. The customer device must have a minimum 1k load resistance. 14AWG wiring is recommended for customer connection.

SCANport (RGU Main Control Board)

The RGU main control board has three available ports for SCANport connections. Port 6 is designed for use with a SCANport interface board.

Figure 15.11
Customer Connections–SCANport (RGU Main Control Board)

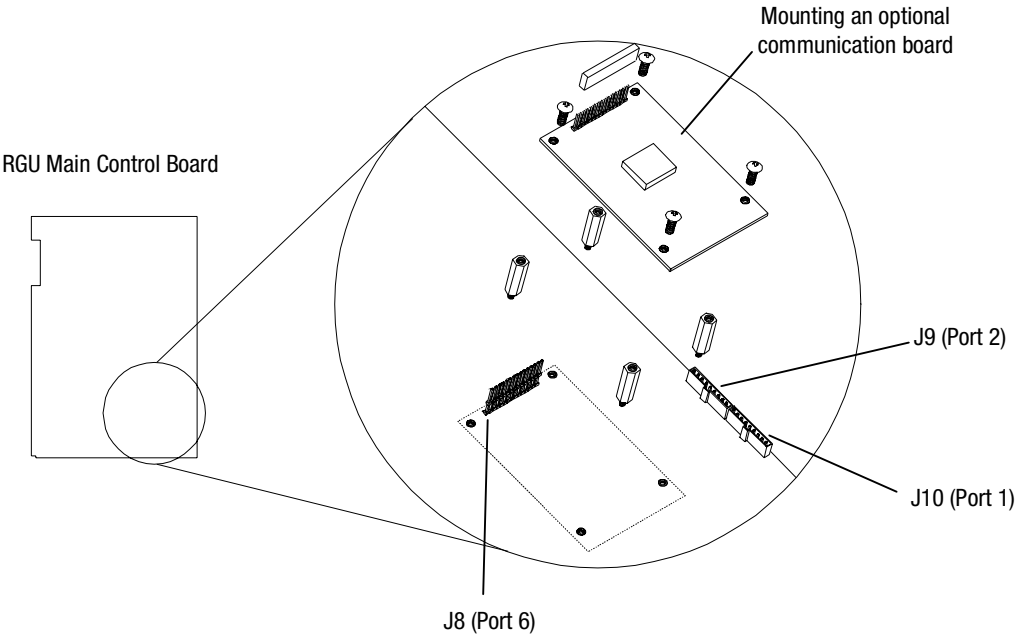


Table 15.A: SCANport Connections (RGU Main Control Board)

Terminals	Description
J8	This port is used for attaching an optional SCANport adapter board onto the RGU main control board (such as a Remote I/O or DeviceNet communication board). This port is designated as Port 6.
J9, J10	These ports are used for connecting SCANport devices. All three SCANports (1, 2, and 6) can communicate simultaneously between the RGU main control board and SCANport devices. J10 is designated as Port 1 and J9 is designated as Port 2.

Terminal Blocks

Figure 15.12
Customer Connections—TB1 and TB2 (NRUs and RGUs)

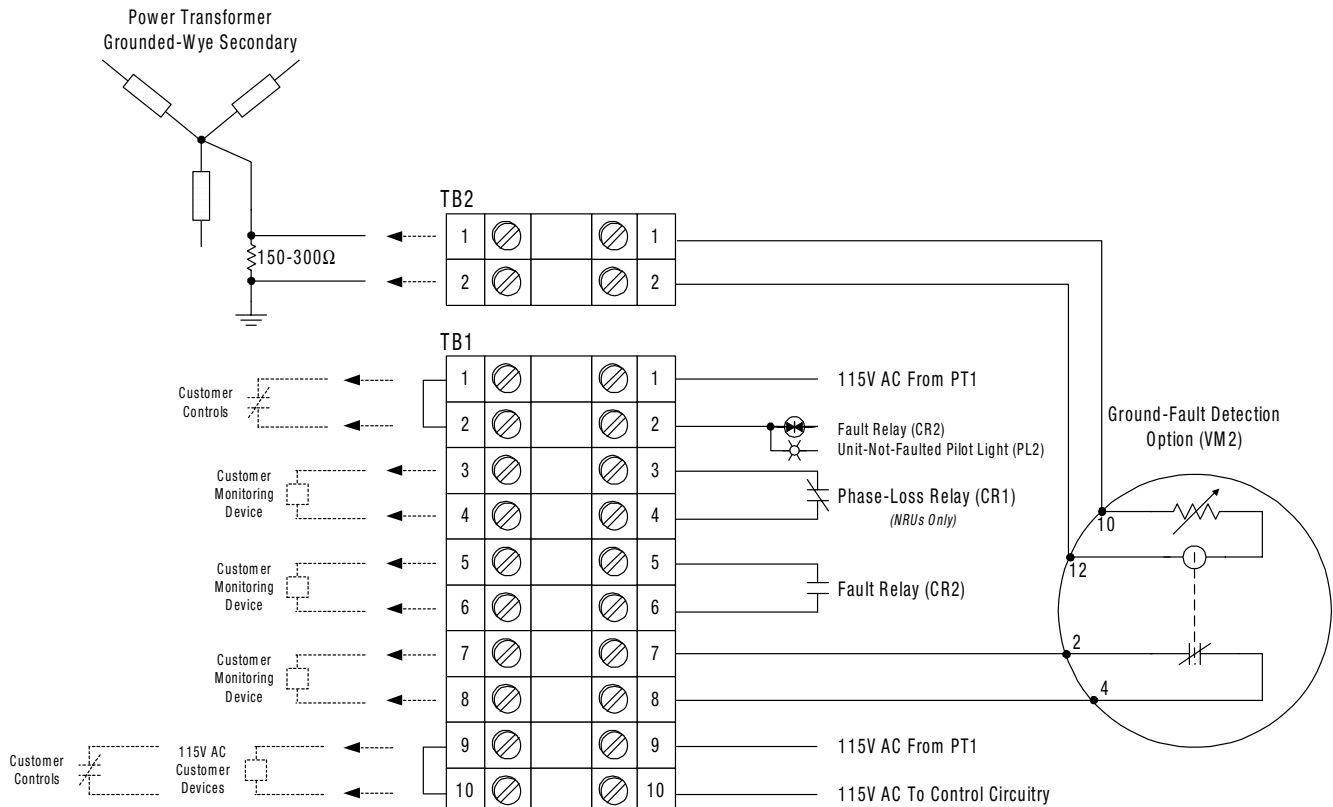
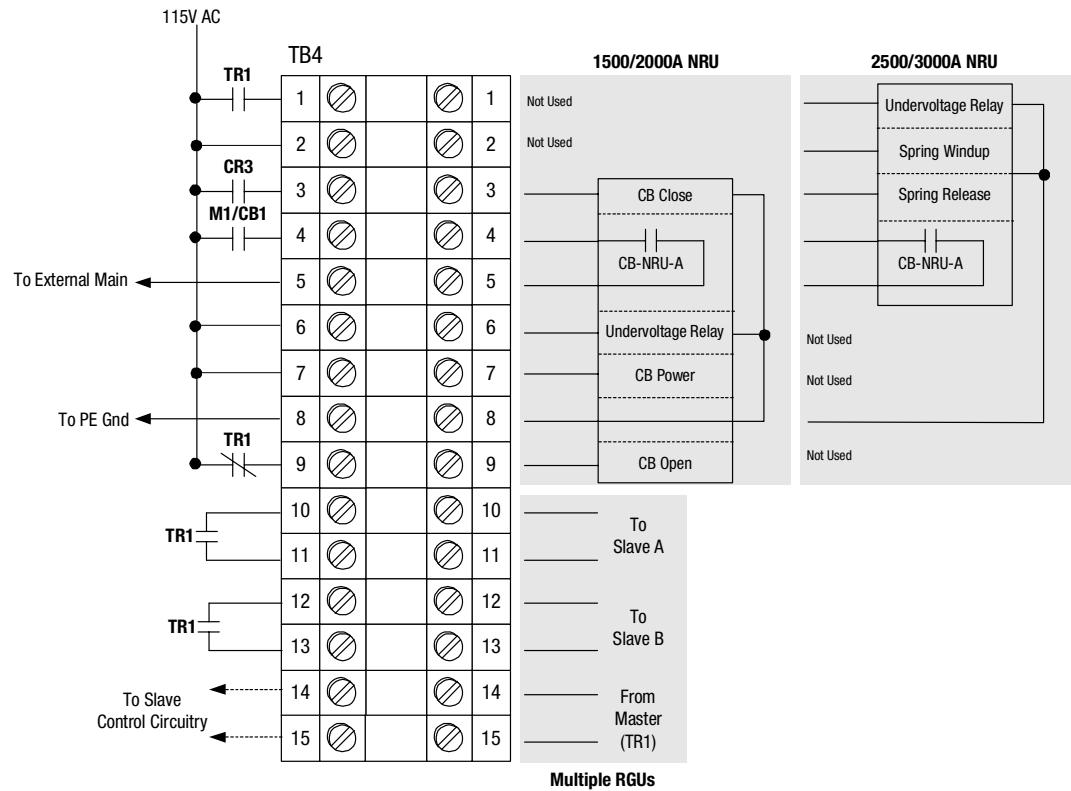


Table 15.A: Customer Connections—TB1 and TB2 (NRUs and RGUs)

Terminals	Description
TB1-1, TB1-2	These terminals are jumpered to allow the Fault Relay (CR2) and the Unit-Not-Faulted Pilot Light (PL2) to operate. The jumper may be replaced with a customer control to externally cut the 115V AC power from the pilot light and fault relay coil.
TB1-3, TB1-4	These terminals connect to the normally-closed contacts on the Phase-Loss Relay (CR1) in the NRU. During normal operation, these contacts will be open. These terminals may be wired to a customer monitoring device to indicate undervoltage, phase unbalance, phase loss, and phase reversal conditions in the AC line. For more information on the phase-loss relay, or other wiring configurations, see the internal wiring section of this chapter.
TB1-5, TB1-6	These terminals connect to the normally-open contacts on the Fault Relay (CR2). During normal operation, these contacts will be closed. These terminals may be wired to a customer monitoring device to indicate overtemperature, phase-loss, and airflow conditions. See the fault relay circuitry in the unit schematics for more details.
TB1-7, TB1-8	These terminals connect to the normally-closed contacts on the Ground-Fault Detection Option (VM2). During normal operation, these contacts will be closed. These terminals may be wired to a customer monitoring device to indicate ground fault conditions. For more information on the ground-fault detector, or other wiring configurations, see the internal wiring section of this chapter.
TB1-9, TB1-10	These terminals are jumpered to allow the 115V AC power to reach the control circuitry. Opening this circuit will cut power to the control circuitry (which, in an RGU, will cause the power circuitry to trip open). The jumper may be replaced with a customer control to externally cut power to the control circuitry.
TB2-1, TB2-2	These terminals connect to the relay coil of the Ground-Fault Detection Option (VM2). If the option is selected, these terminals should be wired across the grounding resistor of the power transformer.

Figure 15.13
TB4 Connections (RGUs)



Configuring the System

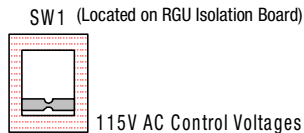
At this point, complete the installation for all the inverters as indicated in the appropriate instruction manuals (but do not connect any power to the inverters at this time).

- Properly install any additional line reactors, fuses, MOVs, filters, controls, or other components, as necessary.
- Complete all internal wiring, grounding, and synchronous communications wiring between drives, as necessary.
- Connect all communication devices, motors, encoders, tachometers, and any other components.

Complete the installation for the parallel configuration (do not connect any power to the parallel configuration at this time).

- Properly install any additional options that have not been installed yet.
- Configure all external communication, control, and monitoring devices.
- Ground any items that are not yet properly grounded.
- For each RGU, verify that SW1 (on the RGU isolation board) is set appropriately (typically (115V AC)). Also, verify that J4 and J5 on the RGU main control board are not jumpered.
- Make sure that the circuit breaker settings are correct, and verify that all circuit breaker switches in the entire system are in the off position. Also make sure that the start switch is turned to off.

Note: More information about circuit breaker settings can be found in 2364E-5.01, 2364F-5.01, or the circuit breaker documentation.



Connecting the AC Input

Isolation Transformer

The parallel configuration should be supplied with a balanced 3-phase input providing the nominal AC line voltage (plus or minus the tolerance). To ensure that the AC input is balanced and isolated, an isolation transformer is recommended.

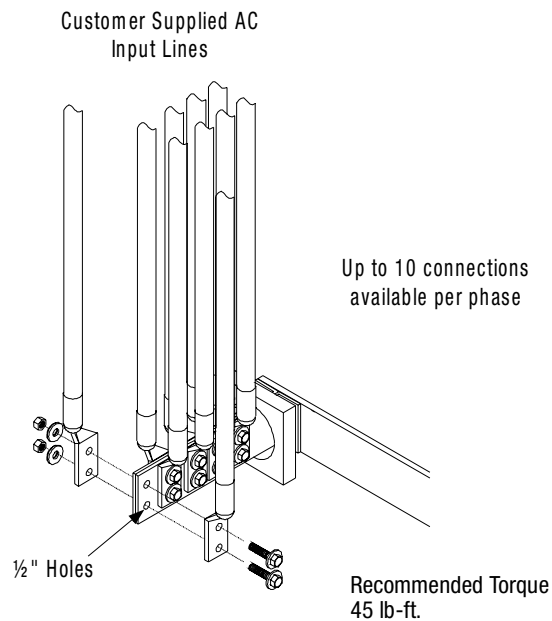
MOV Protection

The units in the parallel configuration are supplied with MOVs to handle voltage surges, high phase-to-phase voltages, and high phase-to-ground voltages. Connecting an input voltage greater than the listed input voltage tolerance may cause the MOVs to be damaged, resulting in a continuous current path to ground.

Feeder Bay

The feeder bay allows top or bottom entry, and allows up to 10 connections to be attached for each phase (on alternate sides of the busbars, if desired). The recommended torque is 45 lb-ft.

Figure 15.14
AC Input Connections



Input Wiring

Select input wiring which is suitable for the input current and application environment of the parallel configuration, in accordance with all applicable codes.

Table 15.A: AC Input Currents

Configuration Code	Rated Line Current (A AC)		
	380 V AC	460V AC	575V AC
R1	1245	1245	1244
R2	1260	1260	1255
R3	1295	1295	1286
R4	1318	1318	1306
S1	1654	1653	1653
S2	1669	1668	1664
S3	1704	1703	1695
S4	1727	1726	1715
T1	2065	2064	2063
T2	2080	2079	2074
T3	2115	2114	2105
T4	2138	2137	2125
T5	2183	2182	2165
T6	2228	2227	2205
V1	2455	2454	2453
V2	2455	2454	2453
V3	2455	2454	2453
V4	2455	2454	2453
V5	2455	2454	2453
V6	2455	2454	2453
W1	1356	1356	1204
W2	1812	1812	1604
W3	2718	2718	2406

Complete all additional power wiring in the system. If any of the inverters or external components will be using separate control power, connect it at this time according to the instructions given in the respective device manuals.

Testing the System

Prepower Checks

1. Using a meter, check that the line-to-line voltage readings are within the tolerance given in Appendix A.
2. Check the line-to-line and line-to-ground (PE) resistance for each unit. All readings should show a high resistance or open circuit.

Testing The System

Before testing the system, verify that all the circuit breakers are in the off position and that the start switch on the parallel configuration is turned to off. The bay doors should be closed.

1. Push each RGU circuit breaker lever to on (do not attempt to use the NRU circuit breaker).
2. Turn the start switch to on. The RGU(s) will begin their precharge operation. When the precharge sequence has finished (about 15 seconds), the NRU circuit breaker will close.

You can check the programming terminal (HIM) for the bus voltage and any fault information.

***Note:** The parameters for this unit may not have been configured yet. If the unit will not operate, skip to chapter 16 to configure the parameters.*

3. Close the inverter circuit breakers and verify that the inverters are receiving power.
4. Open all system circuit breakers.

Setting Up the Parallel Configuration

This chapter will guide you through the setup procedures for the parallel configuration. If you need more information about RGU parameters, please see publication 2364F-5.01.

Introduction to the Human Interface Module (HIM)

The Human Interface Module (HIM), shown in Figure 16.1, can be used to program and set up the RGU. The table below shows the function of the keys.

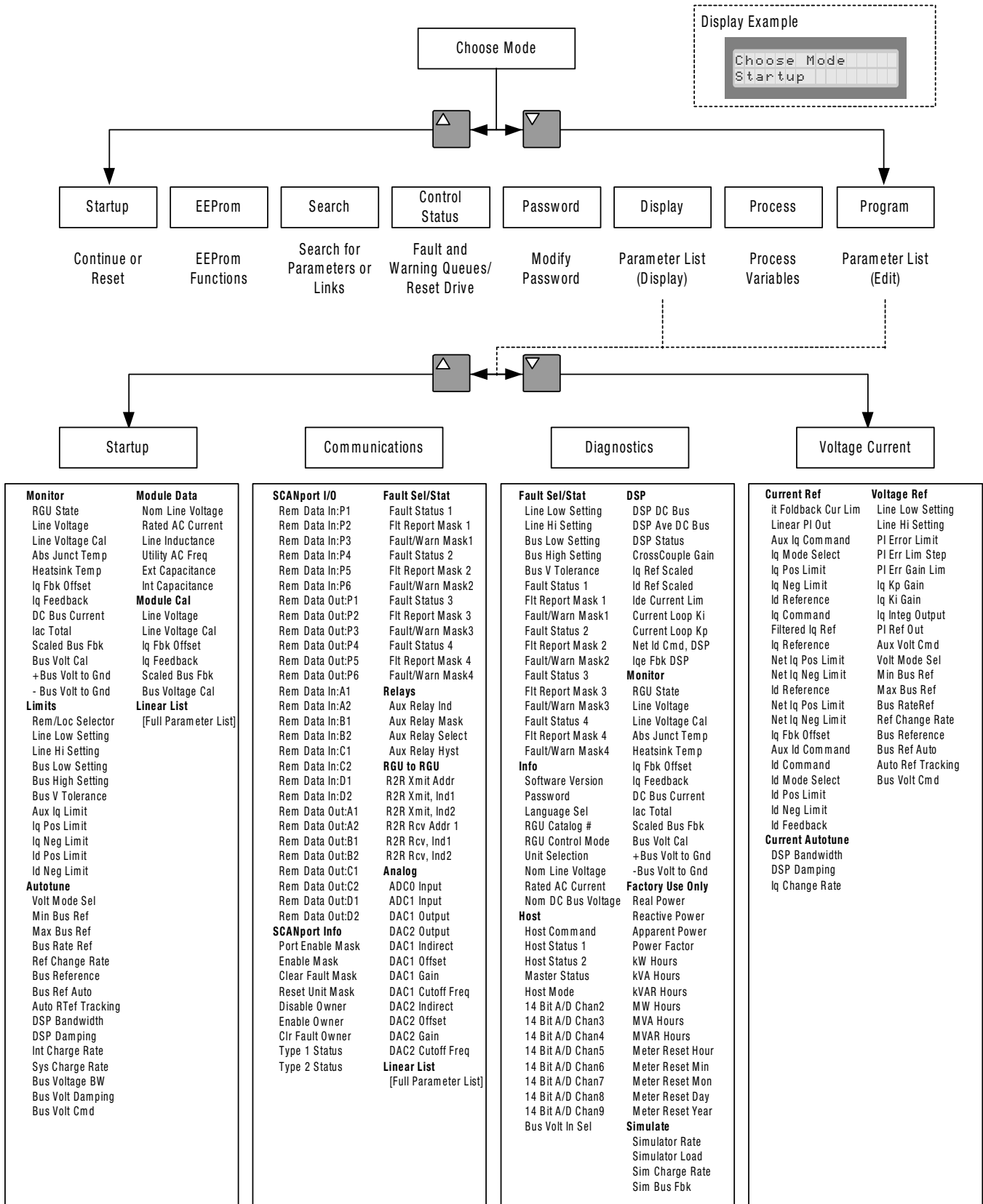
Figure 16.1
Human Interface Module (HIM)



	Escape Pressing the escape key causes the programming system to go back one level in the menu tree.
	Select Pressing the select key alternates between the top and bottom lines in the display.
	Increment Pressing the increment key will increment a displayed value. This key is also used for scrolling through a lists on the display.
	Decrement Pressing the decrement key will decrement a displayed value. This key is also used for scrolling through lists on the display.
	Enter Pressing this key causes a parameter entry to be saved to memory. This key is also used to select items on the display.

The parameters and functions are organized into a *menu tree*. This menu tree is broken into seven modes, including Startup, EEPROM, Search, Control Status, Password, Display, and Process (see Figure 16.2).

Figure 16.2
HIM Menu Tree



Basic Startup Procedure

The basic startup procedure must be performed when starting a new unit to configure the essential parameters for operating the unit.

The following items will be needed when starting up the RGU:

- a multimeter (for reading voltage and resistance)
- a HIM, GPT, or other programming device



ATTENTION: The basic startup must be performed when starting a new unit, replacing the main control board, or upgrading firmware. Improper parameter settings may result in poor performance or equipment damage.

ATTENTION: Do not enable the RGU until the basic startup procedure has been completed.

Starting the RGU

1. Verify that the start switch is turned to off and that the disconnect lever is pushed to off.
2. Verify that the disconnect levers for all inverters are pushed to off.
3. Visually inspect all wiring in the RGU (board connections, DC bus terminals, customer connections, etc.).
4. Push the RGU disconnect lever to on and turn the door-mounted start switch to on. The RGU will power up and perform its precharge routine.

Programming the RGU

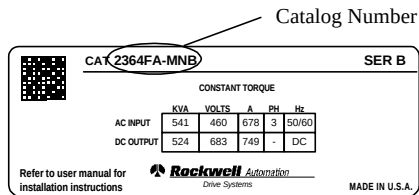
Using a HIM, GPT, or other programming device, enter the linear parameter list. The startup procedure below will guide you through several parameters that need to be configured before operating the parallel configuration. Program each RGU in the configuration.

Frame Catalog Number [P4]

Enter the frame catalog number of each RGU (this should correspond to the catalog number shown on the data name plate of the RGU, located below the main control board.



ATTENTION: Changing P4 will reinitialize all parameters in the RGU and will configure several key parameters to the catalog number selected.



RGU Cat al og #
2364F- MNE

RGU Control Mode [P5]

Set this parameter to the appropriate setting:

- Master Mode (0) Use this setting if this is a master unit in a lineup of multiple RGUs.
- Slave Mode (1) Use this setting if this is a slave unit in a lineup of multiple RGUs.
- Standalone (2) Use this setting if there are no other RGUs in the lineup (default).

RGU Cont r ol Mode
St andalone

Remote/Local Selector [P8]

Set this parameter to the desired setting (Local Only is default):

- Local Only (0) Use this setting for automatic enabling at startup (HIM/GPT not used for enable).
- Remote+Local (1) Use this setting for manually enabling the RGU via a HIM or GPT.

Ren/ Loc Sel ect or
Renot e+Local

AC Line Reactor Inductance [P12]

Determine the total line inductance. This is a sum of the RGU line inductance and the transformer leakage inductance. $P12 = \text{Line Inductance of single RGU} + (\text{Transformer Leakage Inductance} \times \text{\#RGUs})$

The RGU line inductance values are given below.

K-code RGUs	L-code RGUs	M-code RGUs	N-code RGUs
Factory 510 (380/460V) Default 832 (575V)	Factory 317 (380/460V) Default 404 (575V)	Factory 137 (380/460V) Default 191 (575V)	Factory 102 (380/460V) Default 144 (575V)

For transformer leakage inductance, use the following formulas.

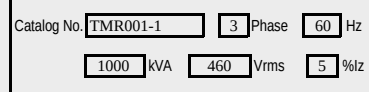
$$\text{Leakage Inductance of Transformer (uH)} = \frac{2.65 \times I_z \times V_{rms} \times V_{rms}}{kVA} \quad (\text{at } 60\text{Hz})$$

I_z Leakage Reactance (%) of Transformer
 V_{rms} Voltage rating (rms) of transformer
 kVA Transformer size

$$\text{Leakage Inductance of Transformer (uH)} = \frac{3.18 \times I_z \times V_{rms} \times V_{rms}}{kVA} \quad (\text{at } 50\text{Hz})$$

Example

A parallel configuration (catalog number 2364PA-T5B) is supplied with a transformer which has the example nameplate shown.



In Appendix B, we find that the catalog number (2364PA-T5B) indicates the has two 460V AC M-code RGUs.

The line reactors for these units are rated at **137 uH** as indicated in the chart above.

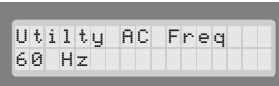
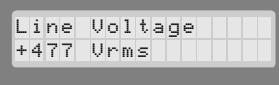
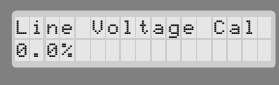
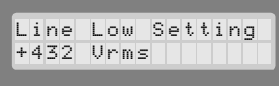
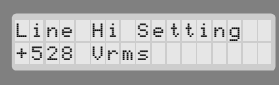
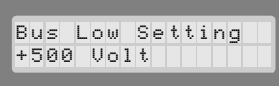
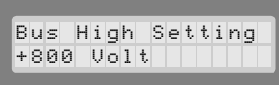
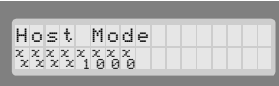
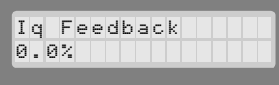
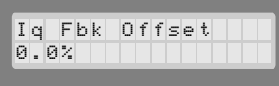
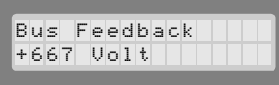
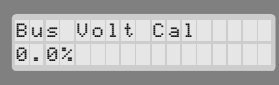
To determine the transformer leakage inductance, we can use the 60Hz formula with the information from the data nameplate.

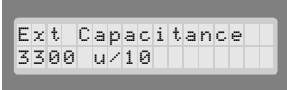
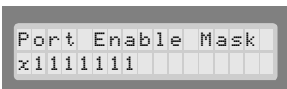
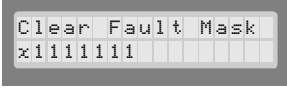
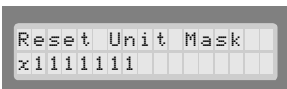
$$\text{Leakage Inductance of Transformer} = \frac{2.65 \times 0.05 \times 460 \times 460}{1000} = \mathbf{28uH}$$

Add the total line reactor inductance of a single RGU to the transformer leakage inductance times the number of RGUs to determine the value for P12.

$$P12 = 137uH + (28uH \times 2) = \mathbf{193uH}$$

Li ne I nduct ance
165 uH

Utility AC Line Frequency [P13] Set the Utility AC Line Frequency (P13) to the frequency of the AC line.	
Measured AC Line Voltage [P14] Using a meter, measure the AC line voltage. Compare the Measured AC Line Voltage (P14) with the meter reading. Determine the adjustment that needs to be made in the RGU (by percent).	
AC Line Voltage Calibration [P15] Set this parameter to adjust the value in P14. If this calibration parameter is changed, check the Measured AC Line Voltage (P14) again.	
AC Line Low Setting [P26] Verify that the AC Line Low Setting (P26) is at an acceptable voltage. Typically, the default setting should be sufficient.	
AC Line High Setting [P27] Verify that the AC Line High Setting (P27) is at an acceptable voltage. Typically, the default setting should be sufficient.	
DC Bus Low Setting [P28] Verify that the DC Bus Low Setting (P28) is at an acceptable voltage. Typically, the default setting should be sufficient.	
DC Bus High Setting [P29] Verify that the DC High Setting (P29) is at an acceptable voltage. Typically, the default setting should be sufficient.	
Host Mode [P35] The bits in the host mode parameter select current limiting functions in the current regulator. Regen Only (bit 0) Limits the motoring current to 10% (regenerative current limit remains at 150%). Err Limiter (bit 1) Limits the gain, step, and value allowed in the bus voltage error. If an NRU is in the configuration, the Regen Mode bit must be activated (P35 bit 0 = 1). The Err Limiter bit should be set to zero (P35 bit 1 = 0). This will prevent overvoltage trip problems in the drives.	
Iq Feedback [P100] Since all of the inverters are disconnected at this time, this value should be 0.0%. Determine the offset that will be required.	
Iq Feedback Offset [P99] Set this parameter to adjust the value of P100 to equal 0.0%. If this offset parameter is changed, check the Iq Feedback (P100) again.	
Bus Feedback [P141] Using a meter, measure the DC bus voltage. Compare the Bus Feedback (P141) with the meter reading. Determine the adjustment that needs to be made in the RGU (by percent).	
Bus Voltage Feedback Calibration [P144] Set this parameter to adjust the value in P141. If this calibration parameter is changed, check the Bus Feedback (P141) again.	

External Capacitance [P203] Determine the maximum amount of capacitance that is expected to be on the DC bus at any one time (a table of inverter capacitances are given in Appendix A). The total external capacitance must be divided among the number of RGUs in the configuration. Important: If additional inverters are added in the future, this parameter must be updated. <u>Example</u> A parallel configuration (catalog number 2364PA-T5B) is connected to a 1336 FORCE (100HP), 1336 PLUS (150HP), and SA3100 (150HP). In Appendix A, we find that the catalog number (2364PA-T5B) indicates two 460V AC M-code RGUs in the configuration. Using the capacitor bank tables in Appendix A (for 460V AC lineups), we have the following values: <table> <tr> <td>1336 FORCE (100HP)</td> <td>900uf/10</td> </tr> <tr> <td>1336 PLUS (150HP)</td> <td>1200 uf/10</td> </tr> <tr> <td>SA3100 (150HP)</td> <td>1200 uf/10</td> </tr> <tr> <td><u>Total Ext. Capacitance</u></td> <td><u>3300 uf/10</u></td> </tr> </table> Since there are two RGUs, half of this value (1650 uf/10) would be programmed into P203 of each RGU.	1336 FORCE (100HP)	900uf/10	1336 PLUS (150HP)	1200 uf/10	SA3100 (150HP)	1200 uf/10	<u>Total Ext. Capacitance</u>	<u>3300 uf/10</u>	
1336 FORCE (100HP)	900uf/10								
1336 PLUS (150HP)	1200 uf/10								
SA3100 (150HP)	1200 uf/10								
<u>Total Ext. Capacitance</u>	<u>3300 uf/10</u>								
SCANport Port Enable Mask [P224] Verify that the appropriate SCANport ports are active. Note the following bits: - SCANport 1 (bit 1) Activates J10 on the main control board (used for HIM, GPT, etc. connection). - SCANport 2 (bit 2) Activates J9 on the main control board (used for HIM, GPT, etc. connection). - SCANport 6 (bit 6) Activates J8 on the main control board (used for optional SCANport interface board).									
SCANport Enable Mask [P225] This setting determines if the start key on a connected SCANport device can be used to enable the RGU. Verify that the appropriate bits are set to 1. Note: P5 (Remote/Local Selector) and P224 (SCANport Port Enable Mask) must be set accordingly if a programming terminal/SCANport device will be used to enable the RGU.									
SCANport Clear Fault Mask [P226] This setting determines which SCANport ports (i.e. J8, J9, or J10) can be used to clear faults in the RGU. Verify that the desired bits are set to 1. P224 (SCANport Port Enable Mask) must be set accordingly.									
SCANport Reset Mask [P227] This setting determines which SCANport ports (i.e. J8, J9, or J10) can be used to reset the RGU. Verify that the desired bits are set to 1. P224 (SCANport Port Enable Mask) must be set accordingly.									

Enabling the RGU

After the basic startup procedure has been completed, the RGU can be enabled. The RGU can be enabled by three different methods.

1. Send an enable command to the Host Command Word by setting the *Enable Cmd* bit (P32 bit 1 = 1).
2. If the Remote/Local Selector has been set to *Local Only* (P8=0), reset the RGU. The unit will automatically enable after the reset.
3. If the Remote/Local Selector has been set to *Remote+Local* (P8=1), press the green start key on a HIM, GPT, or DrivePanel (DriveTools). Note that P224 and P225 must be configured appropriately for this.

Advanced Startup Procedure

This advanced startup procedure may be performed to set the RGU for optimum performance. A HIM, GPT, or other programming device will be required to complete the procedure below.

Id Current Command [P102]

The Id current command determines the amount of reactive current that the RGU should allow. Typically, this value should be set to 0.0% (default).

For applications requiring reactive current, P102 can be adjusted from 60% lagging to -40% leading power factor. If a non-zero value is given as the Id current command, the RGU will run at that percentage of reactive current from the rated AC line current, even if the RGU is unloaded.

Note that reactive current in the RGU takes away from the active, work-producing current (Iq), and reduces efficiency of the RGU. (P102 does not function in slave RGUs.)

Example

If an RGU is set with a -40% leading reactive current (Id), the available active current (Iq) could be determined in the formula $(\%Id^2 + \%Iq^2 = \%I_{total}^2)$.

$$\%Iq = \sqrt{(100\%)^2 - (40\%)^2} = 92\% \quad (\text{Example Only}) \quad [\%I_{total}=100\%]$$

At full load, the total current would be 100%, but the active (work-producing) current would only be 92%. Since P102 only determines the amount of reactive current that the RGU will produce (not regarding the load), the RGU would operate at a power factor of 0 (at no load) and increase to a power factor of -0.92 (at full load).



Id Command
0.0%

Voltage Mode Select [P123]

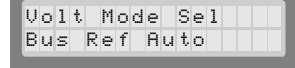
This parameter determines the voltage command that should be supplied to the regulator. The default, 'Bus Ref Auto', selects the value from the Bus Reference Automatic (P129), which is calculated by:

$$P129 = (\text{Measured AC Line Voltage}) \times \sqrt{2} \times 1.042 \quad \text{i.e.} \quad P129 = 460 \times \sqrt{2} \times 1.042 = 678V \text{ DC}$$

If there is an NRU in the configuration, the master RGU must be set to **Bus Ref Auto**.

To maintain the bus at a constant voltage, independent of the AC line voltage, the 'Aux Volt Cmd' or 'Bus Volt Cmd' may be selected. However, note that the RGU will not operate at 1.0 power factor if the specified voltage is less than the peak of the AC line (AC line voltage $\times \sqrt{2}$).

For example, if an RGU is supplied with 460V AC input, but the DC voltage command is set to 640V DC, the RGU would be forced to operate with a some lagging current, which would reduce the efficiency of the RGU. In this case, a voltage command greater than 651V DC ($460 \times \sqrt{2}$) would be a better choice.

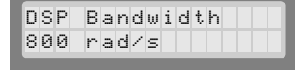


Volt Mode Sel
Bus Ref Auto

Current Loop Bandwidth [P198]

The current loop bandwidth determines the dynamic behavior of the current loop. The current loop becomes more responsive and is able to track faster as the bandwidth is increased. However, note that system limitations and excessive noise may adversely affect the performance of the RGU if the bandwidth is set too high.

Typically, acceptable bandwidth settings are in the range of 800-1000 rad/s (for J or K-code RGUs) or in the range of 600-900rad/s (for L, M, or N-code RGUs). A current bandwidth of 800 rad/s is recommended. In any case, both master and slave RGUs must have the same setting.



DSP Bandwidth
800 rad/s

Set master and slave RGUs with same value.

Current Loop Damping [P199]

The current loop damping determines the dynamic behavior of the current loop. This damping influences the amount of overshoot the current loop will exhibit during a transient. Typically, this value should be set to 100%.



DSP Damping
100 %

Set master and slave RGUs with same value.

Voltage Loop Bandwidth [P205]

The voltage loop bandwidth determines the dynamic behavior of the voltage loop. The voltage loop becomes more responsive and is able to track faster as the bandwidth is increased. However, note that system limitations and excessive noise may adversely affect the performance of the RGU if the bandwidth is set too high.

If the RGU is supplying a single inverter, a voltage loop bandwidth of 200 rad/s is recommended (300 rad/s maximum). If the RGU is supplying multiple inverters, the voltage loop bandwidth should be calculated using the following formula:

$$P205 = \frac{200 \times P204}{P203 + P204}$$

Default values for P204 (Internal Capacitance) are given in the following chart.

K-code RGUs		L-code RGUs		M-code RGUs		N-code RGUs	
Factory	1200 (380/460V)	Factory	1500	Factory	2400	Factory	2400
Default	600 (575V)	Default		Default		Default	

Example

A 460V AC T5 configuration (catalog number 2364PA-T5AB) is connected to a 1336 FORCE (100HP), 1336 PLUS (150HP), and SA3100 (150HP).

The catalog number (2364PA-T5AB) indicates two 460V AC M-code RGUs are in the configuration. The internal capacitance for each RGU is 2400 uf/10 (as shown above). The total external capacitance for the inverters is 3300 uf/10. So P203 will equal 1650 uf/10 for each of the RGUs. Using the formula, we can determine the appropriate value for the voltage loop bandwidth (P205):.

$$P205 = \frac{200 \times 2400}{1650 + 2400} = \mathbf{118 \text{ rad/s}} \text{ (Example Only)}$$

Bus	Volt	BW							
200	rad/s								

Set master and slave RGUs with same value.

Voltage Loop Damping [P206]

The Voltage Loop Damping (P206) also determines the dynamic behavior of the voltage loop. This damping influences the amount of overshoot the voltage loop will exhibit during a transient. Typically, this value should be set to 100%.

Bus	Volt	Damping							
100	%								

Set master and slave RGUs with same value.

Specifications

Table A: Functional Specifications

AC Input Frequency Tolerance	45 to 65 Hz
AC Input Voltage Tolerance	$\pm 10\%$
Overload Capability	150% for 60 sec
Overload Duty Cycle	60 sec every 20 min
Output Voltage Variation	10% max for 100% step load
Resolution of Output Voltage Selection	1.0V
Voltage Regulator Bandwidth	200 rads/sec (nominal)
Current Regulator Bandwidth	1200 rads/sec (nominal)
Minimum Continuous Load Requirement	None
Power Factor	Near Unity
Efficiency	97%
Shock and Vibration	Meets Seismic Zone 4

Table B: Environmental Specifications

Altitude	3,300 ft (1,000 m)
Ambient Temperature	0-40°C (32-104°F)
Relative Humidity	5-95%, non-condensing

Figure 1
Altitude Derating Curve

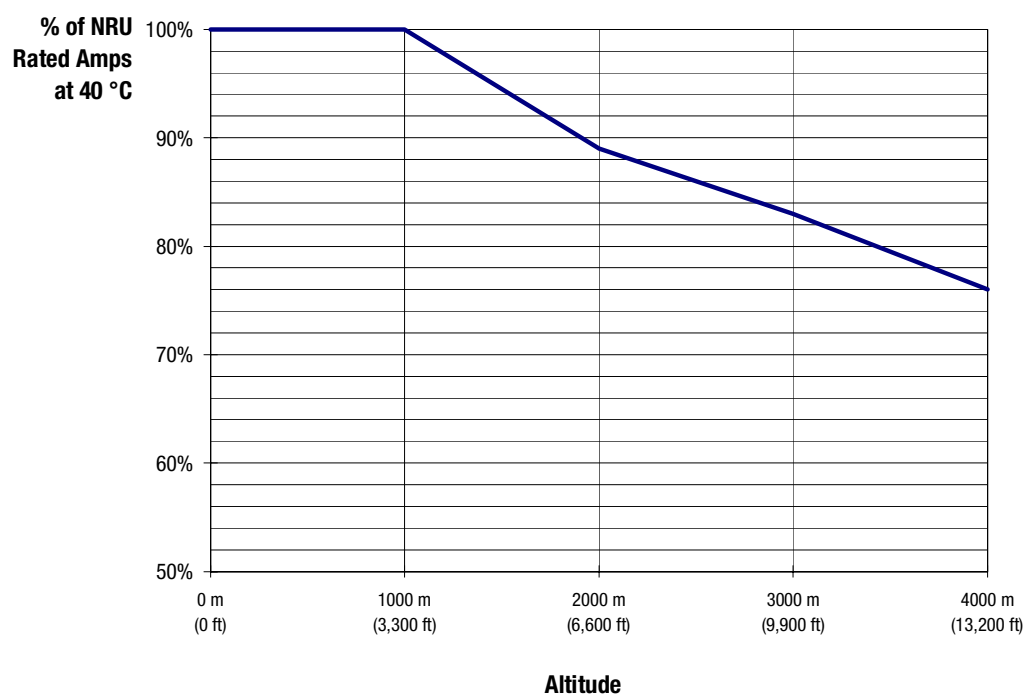


Figure 2
Temperature Derating Curve

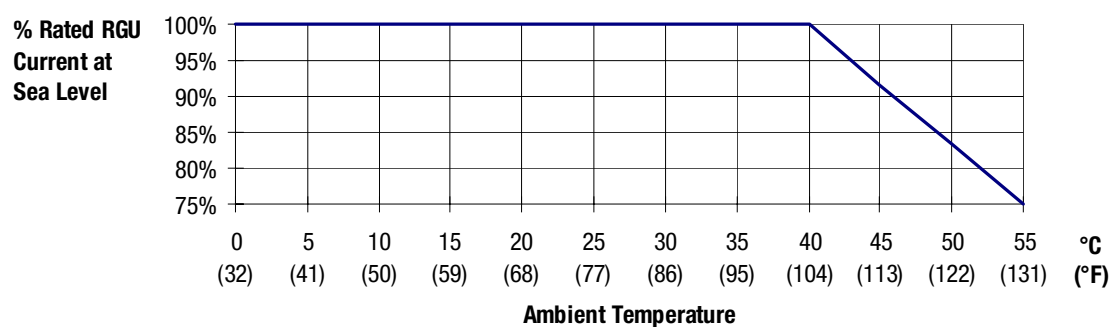


Table C: Operating Sound Level

Configuration	Sound Level (dB)
R1, S1	78.5
R2, S2	84.3
R3, S3	82.5
R4, S4	85.3
T1, V1	79.5
T2, V2	84.6
T3, V3	83.0
T4, V4	85.5
T5, V5	85.5
T6, V6	88.3
W1	85.0
W2	88.0
W3	89.8

Table D: Electrical Specifications–380V AC Input

Catalog Number (2364P-)	Nominal Input Voltage (V AC)	Input Power (kVA)	Nominal DC Bus Voltage (V DC)	Rated DC Bus Power (kW)	Maximum Line Current (A AC)		Maximum Bus Current (A DC)	
					Motoring	Regenerating	Motoring	Regenerating
R1AN	380	820	513	780	1245	182	1520	200
R2AN	380	829	513	788	1260	330	1536	363
R3AN	380	852	513	808	1295	678	1575	746
R4AN	380	867	513	821	1318	906	1600	997
S1AN	380	1089	513	1036	1654	182	2020	200
S2AN	380	1098	513	1045	1669	330	2036	363
S3AN	380	1121	513	1064	1704	678	2075	746
S4AN	380	1136	513	1077	1727	906	2100	997
T1AN	380	1359	513	1293	2065	182	2520	200
T2AN	380	1369	513	1301	2080	330	2536	363
T3AN	380	1392	513	1321	2115	678	2575	746
T4AN	380	1407	513	1334	2138	906	2600	997
T5AN	380	1437	513	1359	2183	1356	2649	1492
T6AN	380	1467	513	1385	2228	1812	2699	1994
V1AN	380	1616	513	1539	2455	182	3000	200
V2AN	380	1616	513	1539	2455	330	3000	363
V3AN	380	1616	513	1539	2455	678	3000	746
V4AN	380	1616	513	1539	2455	906	3000	997
V5AN	380	1616	513	1539	2455	1356	3000	1492
V6AN	380	1616	513	1539	2455	1812	3000	1994
W1AN	380	892	580	865	1356	1356	1492	1492
W2AN	380	1193	580	1157	1812	1812	1994	1994
W3AN	380	1789	580	1735	2718	2718	2991	2991

Table E: Electrical Specifications—460V AC Input

Catalog Number (2364P-)	Nominal Input Voltage (V AC)	Input Power (kVA)	Nominal DC Bus Voltage (V DC)	Rated DC Bus Power (kW)	Maximum Line Current (A AC)		Maximum Bus Current (A DC)	
					Motoring	Regenerating	Motoring	Regenerating
R1AB	460	992	621	944	1245	182	1520	201
R2AB	460	1004	621	954	1260	330	1536	364
R3AB	460	1032	621	978	1295	678	1575	749
R4AB	460	1050	621	994	1318	906	1600	1000
S1AB	460	1317	621	1254	1653	182	2020	201
S2AB	460	1329	621	1265	1668	330	2036	364
S3AB	460	1357	621	1289	1703	678	2075	749
S4AB	460	1375	621	1304	1726	906	2100	1000
T1AB	460	1645	621	1565	2064	182	2520	201
T2AB	460	1656	621	1575	2079	330	2536	364
T3AB	460	1684	621	1599	2114	678	2575	749
T4AB	460	1702	621	1615	2137	906	2600	1000
T5AB	460	1738	621	1646	2182	1356	2650	1498
T6AB	460	1774	621	1677	2227	1812	2700	2000
V1AB	460	1955	621	1863	2454	182	3000	201
V2AB	460	1955	621	1863	2454	330	3000	364
V3AB	460	1955	621	1863	2454	678	3000	749
V4AB	460	1955	621	1863	2454	906	3000	1000
V5AB	460	1955	621	1863	2454	1356	3000	1498
V6AB	460	1955	621	1863	2454	1812	3000	2000
W1AB	460	1080	700	1049	1356	1356	1498	1498
W2AB	460	1444	700	1400	1812	1812	2000	2000
W3AB	460	2165	700	2100	2718	2718	3000	3000

Table F: Electrical Specifications–575V AC Input

Catalog Number (2364P-)	Nominal Input Voltage (V AC)	Input Power (kVA)	Nominal DC Bus Voltage (V DC)	Rated DC Bus Power (kW)	Maximum Line Current (A AC)		Maximum Bus Current (A DC)	
					Motoring	Regenerating	Motoring	Regenerating
R1AC	575	1239	776	1180	1244	182	1520	201
R2AC	575	1249	776	1190	1255	286	1533	326
R3AC	575	1281	776	1218	1286	602	1569	686
R4AC	575	1301	776	1235	1306	802	1591	914
S1AC	575	1646	776	1568	1653	182	2020	201
S2AC	575	1657	776	1578	1664	286	2033	326
S3AC	575	1688	776	1606	1695	602	2069	686
S4AC	575	1708	776	1623	1715	802	2091	914
T1AC	575	2055	776	1956	2063	182	2520	201
T2AC	575	2065	776	1966	2074	286	2533	326
T3AC	575	2097	776	1994	2105	602	2569	686
T4AC	575	2116	776	2012	2125	802	2591	914
T5AC	575	2157	776	2047	2165	1204	2637	1372
T6AC	575	2196	776	2083	2205	1604	2683	1828
V1AC	575	2443	776	2329	2453	182	3000	201
V2AC	575	2443	776	2329	2453	286	3000	326
V3AC	575	2443	776	2329	2453	602	3000	686
V4AC	575	2443	776	2329	2453	804	3000	914
V5AC	575	2443	776	2329	2453	1204	3000	1372
V6AC	575	2443	776	2329	2453	1604	3000	1828
W1AC	575	1199	848	1163	1204	1204	1372	1372
W2AC	575	1597	848	1550	1604	1604	1828	1828
W3AC	575	2396	848	2325	2406	2406	2742	2742

Table G: Typical Capacitor Bank Values in uf/10 (For 380/460V AC Lineups)

Frame Size ⇐	A							B					C	D			E		F		G		H	
	HP ⇐	0.5-1	1.5	2	3	5	7.5-10	15-20	1	3	7.5-10	15	20-30	40-60	60	75-100	125-150	150-200	250	250	300-450	250	300-600	700-800
1336 FORCE/SA3100		-	-	-	-	-	-	-	16	33	135	215	430	645	645	900	1200	1200	1500	-	2070	1500	2400	2400
1336 IMPACT		16	22	33	47	68	135	-	-	-	-	215	430	645	645	900	1200	1200	1500	-	2070	1500	2400	2400
1336 PLUS/1336 PLUS II		16	22	33	47	68	135	135	-	-	-	215	430	645	645	900	1200	1200	1500	2070	2070	1500	2400	-

Table H: Typical Capacitor Bank Values in uf/10 (For 575V AC Lineups)

Frame Size ⇅	A		B		C	D		E		F	G	H	
	HP ⇅	1-10	15-20	1-10	15-20	25-60	75-100	125	150	200-300	350-400	300-600	700-800
1336 FORCE/SA3100		-	-	90	140	290	400	600	900	1500	1800	2400	2400
1336 IMPACT		75	-	-	140	290	400	600	900	1500	1800	2400	2400
1336 PLUS/1336 PLUS II		75	75	-	-	290	400	600	900	1500	1800	2400	-

Table I: Typical Capacitor Bank Values for SA3000 Inverters (in uf/10)

Inverter	56A	70A	112A	140A	192A	240A	534A	972A	1457A
Capacitance	380	470	760	940	1330	1645	3200	6400	12800

Table J: Maximum Number of Inverters Supported by 2364P Configurations

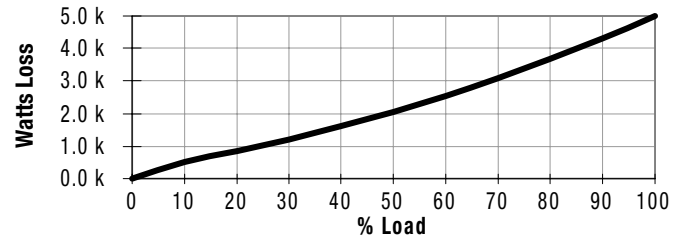
Inverter	R1, S1, T1, V1	R3, S3, T3, V3	T5, V5, T6, V6	W3
	R2, S2, T2, V2	R4, S4, T4, V4	W1, W2	
A1	1500	3000	6000	9000
A2	750	1500	3000	4500
A3	500	1000	2000	3000
A4	230	460	920	1380
B	30	70	140	210
C	20	40	80	120
D	15	32	64	96
E/F	10	20	40	60
G/H	6	16	32	48

Watts Dissipation

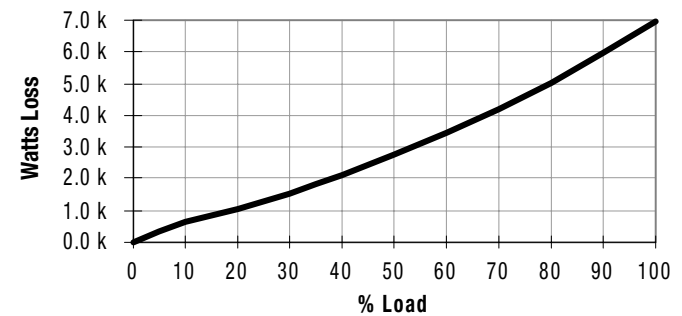
This section provides watts dissipation charts for the individual units in the parallel configuration.

Figure 3
Watts Dissipation vs. Load—NRU

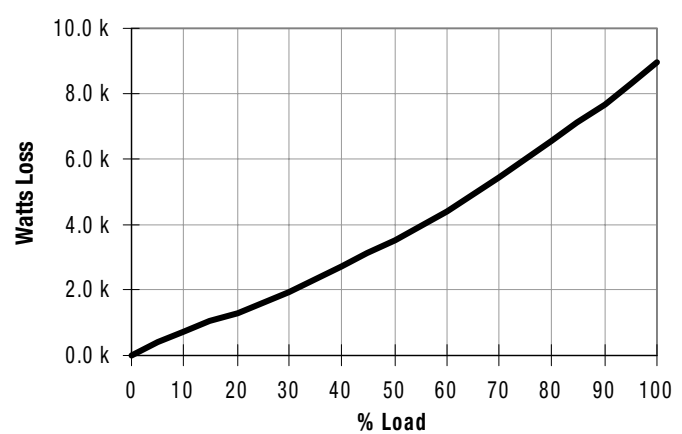
*1500A NRU
(D-code)*



*2000A NRU
(E-code)*



*2500A NRU
(F-code)*



*3000A NRU
(G-code)*

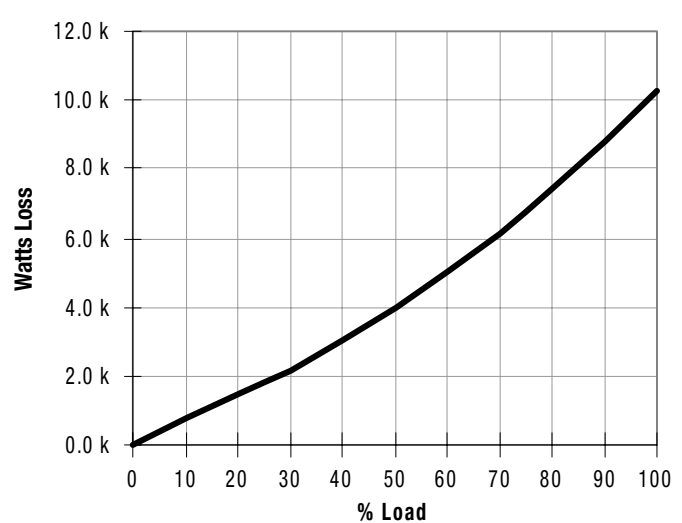
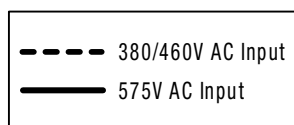
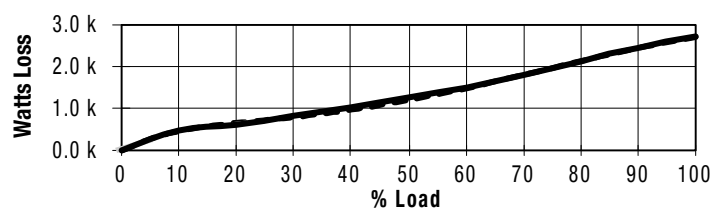


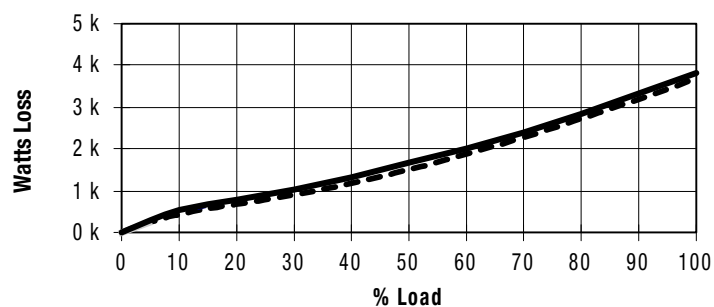
Figure 4
Watts Dissipation vs. Load–RGU



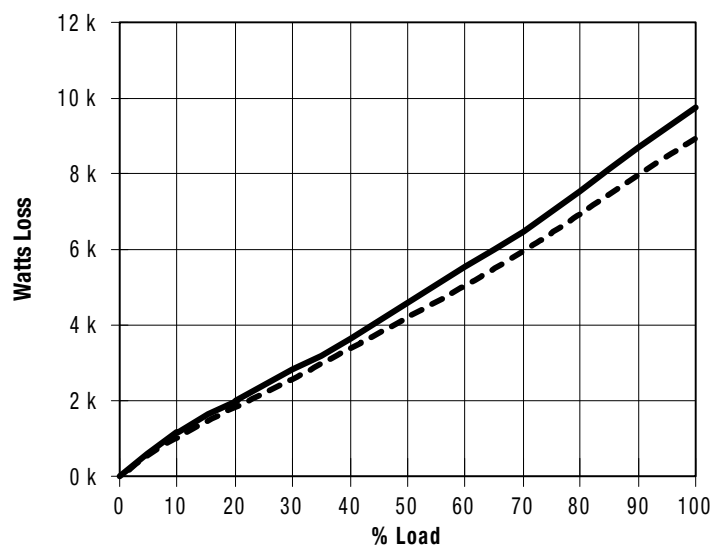
K-code RGU



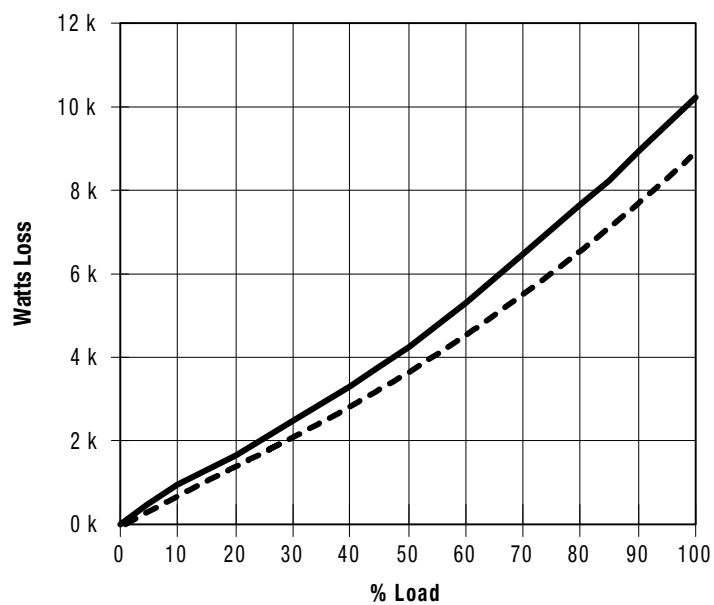
L-code RGU



M-code RGU



N-code RGU



Physical Details

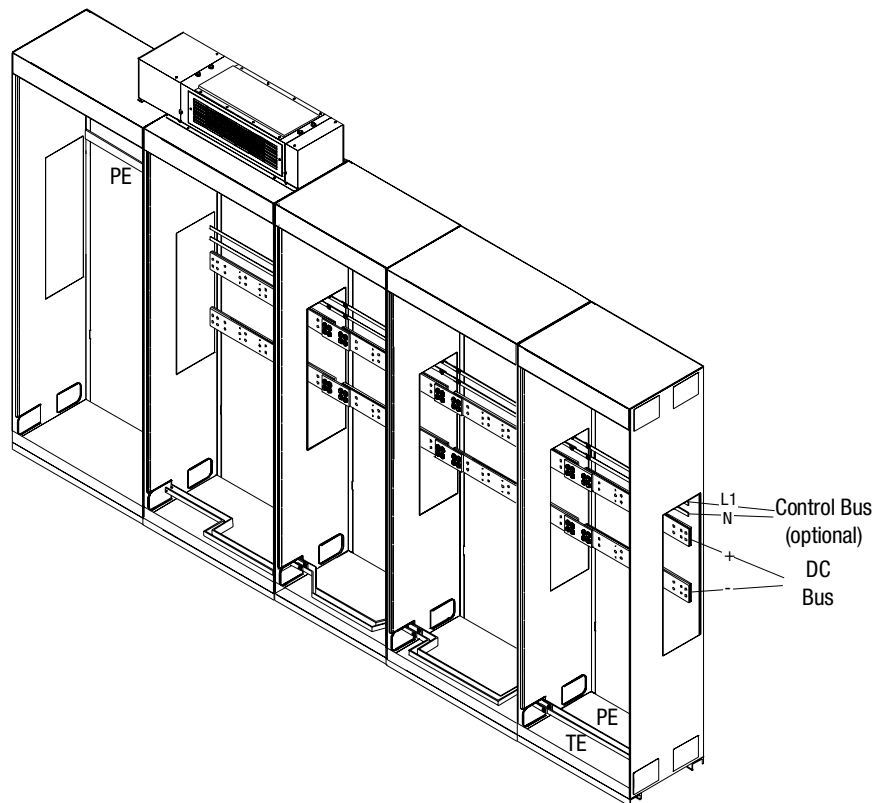
Table K: Dimensions

Configuration	Overall Height	Overall Width	Overall Depth	MCC Sections
R1, S1	101.25"	130"	20"	5
R2, S2	101.25"	140"	20"	5
R3, S3	101.25"	155"	25"	5
R4, S4	101.25"	175"	25"	6
T1, V1	101.25"	140"	20"	5
T2, V2	101.25"	150"	20"	5
T3, V3	101.25"	165"	25"	5
T4, V4	101.25"	185"	25"	6
T5, V5	101.25"	260"	25"	8
T6, V6	101.25"	300"	25"	10
W1	101.25"	195"	25"	6
W2	101.25"	235"	25"	8
W3	101.25"	350"	25"	12

Table L: Shipping Weight

Configuration	Shipping Split 1	Shipping Split 2	Shipping Split 3	Overhead Bus	Total Weight
R1, S1	700 lb (317 kg)	3400 lb (1542 kg)	-	232 lb (105 kg)	4332 lb (1965 kg)
R2, S2	700 lb (317 kg)	3970 lb (1800 kg)	-	232 lb (105 kg)	4902 lb (2223 kg)
R3, S3	2650 lb (1202 kg)	2900 lb (1315 kg)	-	557 lb (253 kg)	6107 lb (2770 kg)
R4, S4	2650 lb (1202 kg)	3850 lb (1746 kg)	-	679 lb (307 kg)	7179 lb (3210 kg)
T1, V1	700 lb (317 kg)	4450 lb (2018 kg)	-	232 lb (105 kg)	5382 lb (2441 kg)
T2, V2	700 lb (317 kg)	5020 lb (2277 kg)	-	232 lb (105 kg)	5952 lb (2700 kg)
T3, V3	3700 lb (1678 kg)	2900 lb (1315 kg)	-	595 lb (270 kg)	7195 lb (3263 kg)
T4, V4	3700 lb (1678 kg)	3850 lb (1746 kg)	-	717 lb (325 kg)	8267 lb (3749 kg)
T5, V5	3700 lb (1678 kg)	2900 lb (1315 kg)	3950 lb (1791 kg)	958 lb (434 kg)	11508 lb (5219 kg)
T6, V6	3700 lb (1678 kg)	3850 lb (1746 kg)	4900 lb (2222 kg)	1202 lb (545 kg)	13652 lb (6191 kg)
W1	3600 lb (1633 kg)	3950 lb (1791 kg)	-	589 lb (267 kg)	8139 lb (3691 kg)
W2	4550 lb (2063 kg)	4900 lb (2222 kg)	-	833 lb (377 kg)	10283 lb (4663 kg)
W3	4550 lb (2063 kg)	4900 lb (2222 kg)	4900 lb (2222 kg)	1458 lb (661 kg)	15808 lb (7169 kg)

Figure 5
Typical Bus Architecture

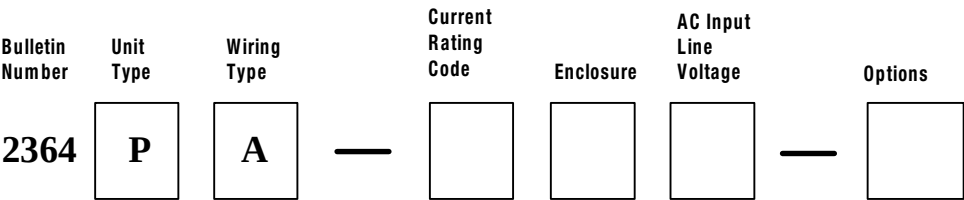


Catalog Numbers and Spare Parts Kits

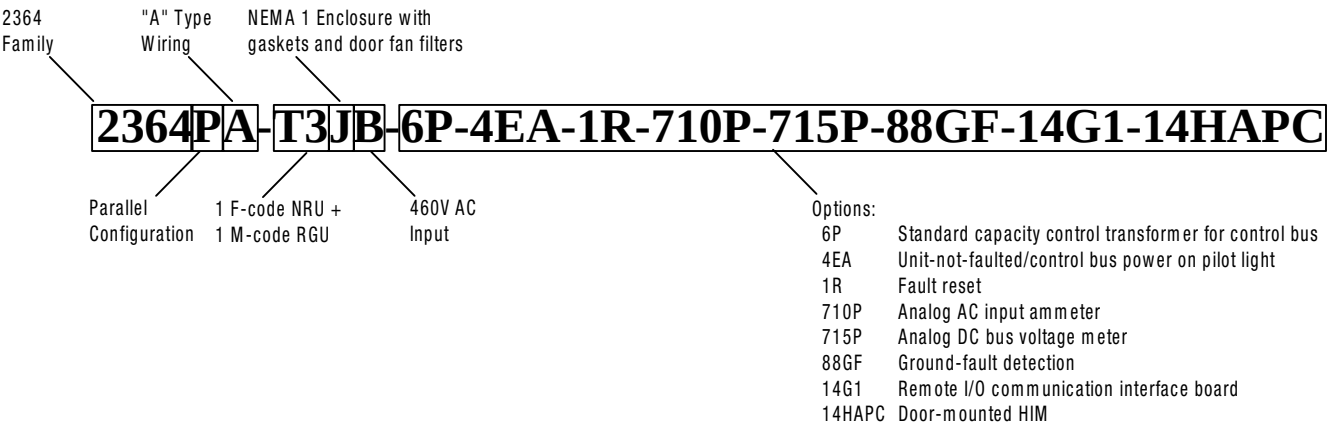
Understanding Catalog Numbers

A catalog number is used to define the components and configuration of a parallel unit. The catalog number is arranged as shown in the following diagram.

Figure 1
Catalog Number Layout

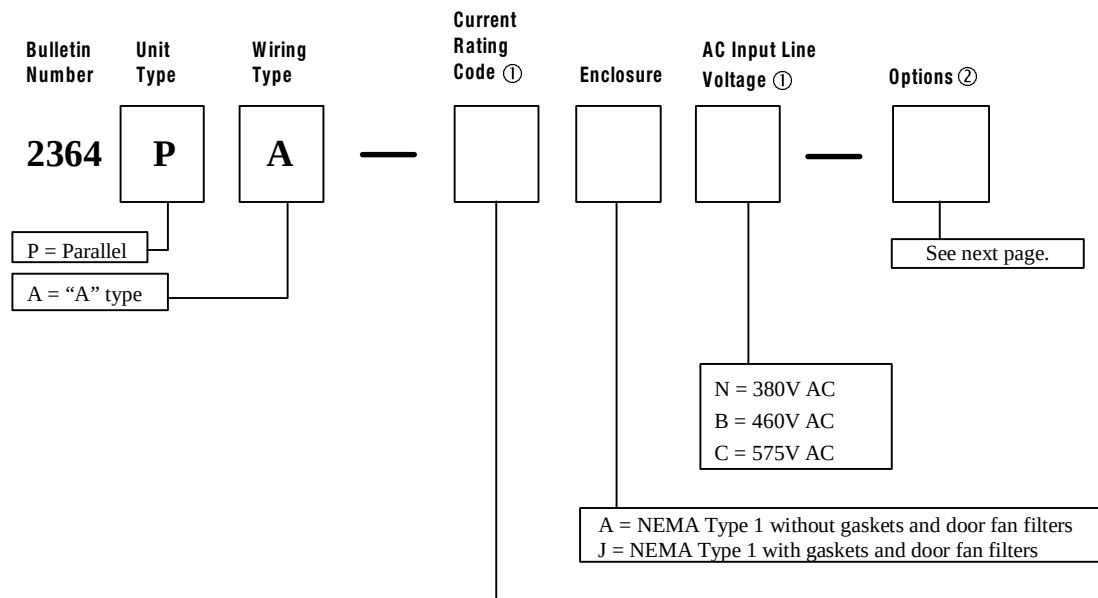


Example



Data Nameplate (in Feeder Bay)

BULLETIN 2300 MOTOR CONTROL CENTER UNIT											
CAT. NO.	2364PA-T3JB-6P-4EA-1R-710P-715P-88GF-14G1-14HAPC										
	SERIES										
ORDER NO.	AQX101	LINE POWER	PH	3	HZ	60	VOLTS	460	AMPS	2114	
SERIAL NO.	AQX101-0001-COMPRXI				STATIC CONVERTOR						
WIRING DIA.	AQX101-0002-2				AC	INPUT-VOLTS	460	AMPS	2114		
H.P.					DC	OUTPUT-VOLTS	621	AMPS	2575		
	FAC				1C		MAXIMUM PERMISSIBLE AVAILABLE SHORT CIRCUIT AMPS				65000
Rockwell Automation											
MADE IN USA											



DC Bus Currents For:					
	380/460V AC Inputs		575V AC Inputs		Configuration Type
	Motoring Current (A DC)	Regenerating Current (A DC)	Motoring Current (A DC)	Regenerating Current (A DC)	
R1 =	1520	200	1520	201	(1) D-code NRU + (1) K-code RGU
R2 =	1536	363	1533	326	(1) D-code NRU + (1) L-code RGU
R3 =	1575	746	1569	686	(1) D-code NRU + (1) M-code RGU
R4 =	1600	997	1591	914	(1) D-code NRU + (1) N-code RGU
S1 =	2020	200	2020	201	(1) E-code NRU + (1) K-code RGU
S2 =	2036	363	2033	326	(1) E-code NRU + (1) L-code RGU
S3 =	2075	746	2069	686	(1) E-code NRU + (1) M-code RGU
S4 =	2100	997	2091	914	(1) E-code NRU + (1) N-codeRGU
T1 =	2520	200	2520	201	(1) F-code NRU + (1) K-code RGU
T2 =	2536	363	2533	326	(1) F-code NRU + (1) L-code RGU
T3 =	2575	746	2569	686	(1) F-code NRU + (1) M-code RGU
T4 =	2600	997	2591	914	(1) F-code NRU + (1) N-code RGU
T5 =	2649	1492	2637	1372	(1) F-code NRU + (2) M-code RGUs
T6 =	2699	1994	2683	1828	(1) F-code NRU + (2) N-code RGUs
V1 =	3000	200	3000	201	(1) G-code NRU + (1) K-code RGU
V2 =	3000	363	3000	326	(1) G-code NRU + (1) L-code RGU
V3 =	3000	746	3000	686	(1) G-code NRU + (1) M-code RGU
V4 =	3000	997	3000	914	(1) G-code NRU + (1) N-code RGU
V5 =	3000	1492	3000	1372	(1) G-code NRU + (2) M-code RGUs
V6 =	3000	1994	3000	1828	(1) G-code NRU + (2) N-code RGUs
W1 =	1492	1492	1372	1372	(2) M-code RGUs
W2 =	1994	1994	1828	1828	(2) N-code RGUs
W3 =	2991	2991	2742	2742	(3) N-code RGUs

Options:		Current Rating Codes:		Available on 2364P Configuration Type(s):		⑨ ⑩ This option is applied:			
				(1) NRU + (1) RGU or (1) NRU + (2) RGUs	(2) RGUs or (3) RGUs	Once per configuration Once per each unit Once per each RGU Once per each NRU			
				Rx, Sx, Tx, Vx	Wx				
<u>Control Power Source</u>	6P = Standard capacity control transformer for control bus ②			x	x	x			
<u>Door-Mounted Pilot Lights</u>	4EA = Unit-Not-Faulted / Control Bus Power On Pilot Light			x	x	x			
<u>Door-Mounted Pushbutton</u>	1R = Fault Reset			x	x			x	
<u>Metering</u>	710P = Analog AC input ammeter (L1 Phase only)			x	x	x			
	715P = Analog DC bus voltage meter			x	x	x			
<u>Protection</u>	14LSP = Line RC suppressor module ③			x	x	x			
	88GF = Ground-fault detection ④			x	x	x			
	14AFL = Cooling fan air-flow-loss switch			x					x
<u>Communication Options</u> ⑤	14G1 = Remote I/O communication interface board			x	x			x	
	14G2 = RS232/422/483 (using DF1 protocol) and DH485 communication interface board			x	x			x	
	14G5 = DeviceNet communication interface board			x	x			x	
	14CN1 = ControlNet communication interface module (mounted separate from power structure)			x	x			x	
<u>Human Interface Module</u> ⑤	14HAPC = Door-mounted HIM (programmer only)			x	x			x	
	14HNBC = Door-mounted SCANport connector (HIM cradle & internal connection cable only)			x	x			x	
<u>Unit Door Nameplates</u> ⑥	M3EW = White background with black lettering; phenolic label			x	x		x		
	N3EB = Black background with white lettering; phenolic label			x	x		x		
	N3ER = Red background with white lettering; phenolic label			x	x		x		
<u>Miscellaneous</u>	14WLBL = Brady Datab [™] wire labels ⑦			x	x		x		
	J12 = 115V DC, 15A duplex receptacle ⑧			x	x		x		
	J11 = Audio phone jack			x	x		x		

Footnotes:

- ① The configurations presented are the only standard configurations available. You may not change the order of any units or individual bays within a configuration.
- ② Each parallel configuration includes a basic capacity control transformer(s) to supply only the parallel configuration with power. Control power source option(s) allow you to select a higher capacity control transformer for control bus applications. Control power source option(s) includes a control bus fuse and the control bus.
- ③ The line RC suppressor is recommended for installations where the primary of the distribution transformer is 2300V AC or greater.
- ④ Power transformer must have a resistive, grounded-wye secondary where the resistance is 150 ohms.
- ⑤ You may select up to one option from this group.
- ⑥ You must select one option from this group.
- ⑦ Units come standard with cloth wire labels. Datab labels offer the added protection of a clear plastic cover on top of the labels.
- ⑧ Customer supplies 115V AC control power and wiring to the duplex receptacle.
- ⑨

<u>This term:</u>	<u>Refers to:</u>
configuration	The entire 2364P, consisting of RGUs, NRUs, and any additional hardware required.
each unit	A 2364P is comprised of RGU(s) and/or NRUs. Each RGU/NRU is considered a "unit".
each RGU	The entire RGU (comprised of 1, 2, or 3 MCC-sections, based on current capacity).
each NRU	The entire NRU (comprised of 1 or 2 MCC-sections, based on current capacity).
- ⑩ In all configurations with an NRU (Rx, Sx, Tx, Vx), options specified as once per configuration will be located in the NRU. In all other configurations (Wx), options specified as once per configuration will be located in the master RGU.

Spare Parts Kits

See publication 2364-6.0 for a listing of spare parts available for your 2364P configuration.

Control Power Filter

A filter used to reduce harmonics and noise in the 115V AC control power.

Disable

When a unit is disabled, the control logic is not directing current flow operations. A unit is typically disabled by a disable command or by a fault condition.

Disconnect

A circuit breaking device.

Enable

When a unit is enabled, the control logic is directing the motoring or regenerative current by modulating its hardware (IGBTs).

Feedback

Signals from the hardware which indicate the hardware status to the control logic.

Gate Driver Board

The RGU gate driver board is responsible for modulating the power modules and supplying power to the control boards. The gate driver board is interfaced with the main control board.

Graphic Programming Terminal (GPT)

A programming terminal with a graphical LED display and a pushbutton keyboard which is used to program, control, and view the status of a unit. The GPT is also able to load and store parameters in its local memory.

Host Processor

The main processor on the main control board of the RGU. This component processes feedback and controls most of the activities in the RGU.

Human Interface Module (HIM)

A programming terminal used to program, control, and view the status of a unit.

Insulated Gate Bipolar Transistor (IGBT)

A transistor which can be used to allow current to flow in two opposite directions. Also known as *power module*.

Isolation Board

The RGU isolation board receives direct feedback from the AC line, DC bus, and current transducers. This board supplies scaled feedback to the main control board.

Main Control Board

The RGU main control board regulates the voltage and current, oversees activities in the unit, and processes I/O. This board is isolated from the power circuitry.

Metal-Oxide Varistor (MOV)

A component used to protect against voltage surges and excessively high line-to-line/line-to-ground voltages.

Motoring Current

Current which is being supplied to the inverters (through the DC bus) for motoring.

Non-Regenerative DC Bus Supply Unit (NRU)

A six-pulse DC power supply produced by Rockwell Automation. The NRU is typically used as a front end power supply on a drive system lineup.

NRU//RGU Configuration

A parallel configuration of one or two RGUs connecting to an NRU.

Overload

A condition where the unit is supplying current above its rated current. For example, operating a unit at 150% overload would indicate that the unit is supplying 150% of its rated current. Most units can operate with an overload condition for a short period of time.

Power Factor (pf)

A measurement of the time phase difference between the voltage and current in an AC circuit.

Power Structure

A 3-phase power bridge built in the RGU which converts AC to DC (motoring current) and DC to PWM AC (regenerative current). The power structure includes control boards, a precharge circuit, a power bridge, and a capacitor bank.

Regenerative DC Bus Supply Unit (RGU)

A regenerative DC power supply unit produced by Rockwell Automation. The RGU is typically used as a front end power supply to provide motoring and regenerative current for a drive system lineup.

Regenerating Current

Current which is being driven back from the motors (from motoring induction) to the DC bus. RGUs are able to place regenerating current back onto the AC line.

RGU-to-RGU (R2R) Communications

A communication link used between master and slave RGUs. In R2R communications, the master RGU passes current commands, status information, and synchronization signals to the slave RGUs.

RGU//RGU Configuration

A parallel configuration of two or three RGUs (no NRUs).

Shipping Split

The parallel configurations are shipped in separate pieces which must be fixed together.

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